ENGINEERING NEWS

THE New York & Long Island Railroad Company has petitioned the Board of Aldermen of New York City for a permit to construct and operate its proposed railroad and tunnels within the limits of New York City. The route of the proposed lines, which are wholly underground, is from near Hunter's Point, Brooklyn, underneath the East river and through subterranean New York between 35th and 30th streets to a terminus between Ninth and Tenth avenues and 29th and 30th streets, where the tunnel comes to the surface. Branch tunnels are to run from 34th street to Grand Central Depot and from 30th street and Ninth avenue to a connection with the Hudson river tunnel near the foot of Christopher street. The main line will consist of two adjacent parallel tunnels, the crowns of which will be at an average depth of about 50 ft. beneath the surface, a depth which is considered sufficient to avoid all interference with sewers, water and gas pipes. Electricity is to be used for propelling the trains and the elevators for transferring passengers from the road level to the surface. The excavation for tunnel will be almost entirely in solid rock. ROY STONE is President of the Company, and OLIVER W. BARNES is Chief Engineer.

THE Maine Central Railroad has taken prompt action in accordance with our suggestion as to a revision of station names to avoid possible confusion of them in train orders. We hope and suppose that various other roads have done the same, since the result on the Maine Central shows how many names there are which can possibly be confused. In five successive general orders the names of eleven different stations were changed, and this in spite of the fact that it was not deemed feasible to attempt to change the public name of the stations but only their name in train-orders. Much the same end can be attained, however, and perhaps more simply, by adding the telegraphic call of each station to its name in train orders, these calls being very distinctive and rarely having much resemblance to the name.

A BILL has been introduced in the New York legislature making it unlawful to construct grade crossings for highways or railroads without a special order from the Courts, after ten days' notice to the other side; and providing that on petition of any parties in interest "three disinterested and competent commissioners, one of them a Civil Engineer" shall be appointed at the liberal compensation of $10 per day, to determine whether the elimination of any existing crossing is expedient, and who shall pay for doing it. The number of "competent civil engineers" for such work who can be had for $10 per day is not large, but the bill in its main features is a good one.

THE annual report of the Massachusetts Railroad Commission, advance copies of which have just been received, is full of interesting matter, which we hope to summarize more fully later, but the data as to the really remarkable progress in Massachusetts of steam heating from the locomotive are of especial interest, It appears that there are now eight systems in practical use, as follows:

Emerson, on all Connecticut River cars.

Gold, 20 cars on Boston & Providence.

Henney, 1 train, on N. Y. N. H. & Hartford,

Martin, 101 cars on Boston & Albany, and to go on all the rest during the winter (a highly enlightened and creditable promptness, which places it easily at the head of all the corporations of the country in this respect.)

Wilder, some 30 cars on the N. Y. & New England, Old Colony, and N. Y. N. H. & Hartford.

Sewall, on about 60 cars on 7 different lines.

Two special systems invented by officers of the roads are also in use on the Boston & Providence and Boston Revere Beach & Lynn, the latter being fully equipped, "thus being" says the Commission "the first railroad in the Commonwealth, and probably in the world, to abolish separate heaters in all cars and heat entirely by steam from the locomotive;" —a rather funny forgetfulness of the Manhattan Railway, which has been heating its 850 cars entirely by steam for some nine years.

THE probable financial collapse of the Panama canal is exciting great interest and apprehension in Europe. It may even shake the French Government itself. Of 59,000,000 of shares, held by 102,230 persons, 80,839 own only 1 to 5 shares each, and only 2,248 more than 20 shares each. Most of the $150,000,000 loaned on bonds was also from small and new investors, so that it is estimated that from 400,000 to 500,000 different heads of families will suffer at what seems the inevitable end. The obligations of the company are already $324,500,000, and the work is but begun.

THE French Cabinet has refused by a unanimous vote M. LESSEPS application for permission to issue a lottery loan, and Panama canal shares have had a heavy fall in consequence. It is hard to see what the company will now do, as last year's loan was only floated in part and at the great sacrifice of a $200 bond for $88 cash, and this with the equivalent of a lottery feature, viz., that a certain proportion of bonds were to be drawn each year by lot and paid off at par. The rather more than doubtful "temporary" lock scheme, on which we have commented in this issue and previously, *may* help somewhat, but we should think would have rather a contrary effect.

ACCORDING to Paris report the general meeting of the Panama Canal Co. appointed for Jan. 28, has been postponed until March. The reason given is that the number of shares deposited is not sufficient, according to the charter, to call the meeting.

PANAMA news, of Jan. 16, says that the firm of ERZINGER, DEPHIEUX & Co. have contracted to build the projected locks on the Panama canal and have already commenced work at Bohio-Saldado, where the first locks on the Atlantic side are to be built.

THE very objectionable and awkward feature of the Brooklyn bridge grip gear, that grips can only be taken at the termini, resulted in another annoying delay this week. The grip was out of order on the car, resulting in its being taken wrong on the following cars of the train. This compelled a stoppage of traffic, in order to do which other trains had to drop the grip, as there are no means of resuming the cable *en route*, several trains had to return to the termini, greatly increasing the delay, which amounted in all to about half an hour at the most crowded hour of the day. A mob of several thousand people accumulated around the Brooklyn terminus with the thermometer in the neighborhood of zero and many hundred walked across. "A similar occurence has not been experienced for several months," says the *Eagle*, but there is no need nor excuse for its ever occurring, since it is a simple matter to arrange the grip gear so as to apply and release at any point and safety as well as convenience imperatively demands it.

THE scheme of elevating the tracks through Pittsburg seems to be assuming large proportions and to be in a fair way of going on. Definite plans for works to cost $2,000,000 have been prepared by the Pennsylvania Company, and this is only a part of what is proposed. With its usual liberality and foresight in such matters the Pennsylvania Railroad is furthering instead of opposing this improvement, in broad contrast with the narrow attitude of the roads centering in Buffalo, where the necessity of improvement is much more urgent than in Pittsburg.

THE *Chicago Tribune* credits the Rev. Father DONOHUE, of Charleston, Ill., with the discovery of a new explosive that is to far excel any known compound in deadly effect. It is called *Latofer Quate* and it somewhat resembles the Russian *lectover*—whatever that is. All that our contemporary knows of its form and composition is that—"it is put up in fuses and is made from pine gum." This description is a little vague, but probably no more so than the reputed discovery itself.

THE New York, New Haven & Hartford Railroad has expended some $50,000 in perfecting the block signal system on its New York division, between New Haven and New York, and will probably extend the system to other divisions over which through express trains run between Boston and New Haven. Twenty-five wooden signal towers, similar to those between Boston and Worcester on the Boston & Albany Railroad, have been erected three miles apart, and an operator is to be on duty at all times, day and night. When a train passes one of these towers, a danger signal is lowered, and remains down until the next tower is reached, when the first signal is raised by the agency of electricity. No train is allowed to pass any tower while its signal is at danger.

BY popular vote, the city of Columbia, S. C. guarantees $200,000 towards the completion of the State canal. This canal is to furnish 30,000 horse power and be used besides as a waterway between Charleston and the interior of South Carolina by way of the Broad and Saluda rivers.

THOUGH somewhat accustomed to hearing of terrific outbursts of oil—or gas—from the petroleum deposits of Baku, the last report therefrom beats the record. It is to the effect that a well on the property of a Mr. ARABELOFF was jetting oil at the rate of "2,400 tons daily" and had been doing this continuously for four weeks. If this report is anywhere near true, there is a criminal waste of useful fuel going on in that region, and the further report that the Russian Government is taking steps to check this waste is a step taken none too soon.

ACCORDING to a short paper read before the Engineers' Society of Western Pennsylvania, on Jan. 17, Mr. THOMAS J. BRAY has succeeded in the manufacture of welded steel tubes at the Riverside Iron Works, of Wheeling, W. Va. The paper does not enter into the process, but makes the claim that from a special steel made in a Bessemer converter a product is obtained which is tough and yet smooth in working, and fully overcomes the difficulties of manipulation, in the form of tubing, in threading, butt-welding, etc.

THE Staten Island bridge question is to come up next October before the Supreme Court at Washington, on the appeal of the State of New Jersey from the decree granted by Justice BRADLEY, last August. The ground of the appeal is, that the decree is erroneous, for that it deprives the State of New Jersey of its private property for an alleged public use without just compensation, and deprives the State of its property rights guaranteed to it by the fifth amendment to the Constitution of the United States of America, and also of the rights guaranteed to it by article one, section eight, of the said Constitution of the United States of America; also the rights guaranteed to it by the tenth amendment to the Constitution aforesaid.

THE most serious railroad accident of the week was a derailment Jan. 23 on the Delaware & Hudson Railroad. The cars of a south bound passenger train jumped the track at Baxterville, N. Y., and went down an embankment, being badly wrecked. The accident is attributed to a broken rail. About 16 persons were injured, 4 of them probably fatally.

AMONG the other railroad accidents of the week, there are 7 reported to have been caused by broken rails and 2 by broken wheels. A broken flange was discovered on a wheel of a train on the New York & New England Railroad; a wreck being thus probably prevented.

THE Rogers Locomotive works, at Paterson, N. J., were damaged by fire, on Jan. 23, to the extent of $100,000 as now estimated.

THE shore shaft of the Chicago lake tunnel is reported to have encountered a pocket of quicksand and water, and progress is temporarily suspended. It was struck on Jan. 21, and the first rush filled the shaft to a depth of about 15 ft. Of the 75 ft. total depth of the shaft, 55 ft. had been solid clay. The machinery is all in place for going ahead and the occurence simply means some unexpected delay and extra expense. The shaft will be 100 ft. deep.

THE first locomotive passed through the Minn. & Northwestern tunnel, near Galena, Ill,, on Jan. 19, and regular traffic through it is now open.

Irrigation in Spain.*

Artificial irrigation is absolutely necessary in a climate like that of Spain, where the dryness of the atmosphere joined to a meagre and irregular rainfall does not supply the amount of moisture requisite for the cultivation of certain crops.

Before entering upon a description of some of the methods adopted to supply the deficiencies of natural rainfall, it is proper to relate some of the peculiarities of the climate, or rather the climates of Spain, for the accidents of soil and the conditions of location fundamentally modify the climatology of different sections of the peninsula.

The quite narrow zone bordering the Atlantic on the north of Spain has a humid climate, mild and temperate; and these conditions are still more pronounced on the west side which is more exposed to the winds from the ocean. The mean temperatures of this region are, in winter, 8.5° C; in the spring, 12°; in summer, 19.5° and in the autumn, 14.3° C. The mean, maximum and minimum are respectively 36° and—4° C. The mean annual rainfall at Oviedo is 3.07 ft., and touches 5.7 ft. at Santiago. As to the frequency of rains, there are from 156 to 172 days of rain in the year in these regions.

The climate of the zone washed by the waters of the Mediterranean is hotter, extremely dry at a short distance from the seashore, but generally mild. The mean temperatures are, at Barcelona, 9.8° in winter; 14.6°, in the spring; 23.4°, in summer; 17.5° in autumn; or, 16.3° for the average of the year, and with maxima and minima, of 32.3° and 0.1° respectively; all being according to the Centigrade scale. The total annual rainfall at Barcelona is 24.28 ins., and at Valencia only 13.36 ins. The days of rain number 44 at Alicante, and 73 at Barcelona.

It is necessary to take into consideration the ruder climate of the upper regions including the basins of the great rivers, and also that of the great plateau of the two Castiles, covered in the spring with verdure, and dry and burned out afterwards by the hot sun, until the autumnal rains again revive them. Upon the plateau of Old-Castile the average annual temperature is 10.7° (C) with maxima and minima of 35.4° and—9.0° at Burjos. The total rainfall at Salamanca is 10 in., and at Soria it is 14.68 ins. for the year. The mean annual rainfall over the whole plateau of New-Castile ranges from 13.36 to 15.28 ins.

To give some idea of the climate on the east coast, where the sugar-cane is cultivated in the open air with the other tropical plants, it is only necessary to cite some of the meteorological observations made at Malaga in 1876-1880. The mean annual temperature is 19.3° (C), with maxima and mimima of 41.0° and + 2.5° (C). The total annual rainfall is 21.32 ins. with 50 rainy days in the year.

The amount of evaporation of water from an open tank amounts to 4.92 ft. in depth per annum in the central part of Spain; an amount four or five times as great as that which falls in the form of rain. This disproportion is still greater in the plains of Murcia, where the quantity of water evaporated from an open tank reaches the figure of 6.71 ft. per annum while the greatest rainfall only amounts to 13.36 ins. per year. These facts make sufficiently apparent the importance of artificial irrigation in a country burned by an ardent sun and possessing during the greater part of the year a dry, serene and transparent atmosphere.

With the exception of the Cantabrian zone and some regions in the upper river basins, in the greater part of the country and for the greater number of crops, irrigation is an absolute necessity. In certain favored regions water is of such a comparatively small value that no one hesitates to use it, even when it requires well-boring to a depth of 100 to 120 ft.

Works for the supply of water necessary for irrigation date, in Spain, from a remote period, and the succession of progress in agriculture marks the stages of this development in the various periods of Spanish history. The excellent works of the French scientists, JAUBERT DE PASSA and MAURICE AYMARD, upon irrigation in Spain, are too well known to need mention here; but it should be understood that, in all times of private activity in Spain, it has been sought to utilize for agricultural purposes the waters under the river beds and in the gravel; otherwise going to waste into the ocean. The great works of modern times can be arranged in three groups: (1) Works projected and constructed by a syndicate of proprietors. (2) Works projected and constructed by corporations intending to sell water to the farmers; (3) Works entirely carried out at the expense of the State.

Of irrigation works of importance belonging to the first class, we can note the *Canal de la Infanta*, with its source in the river Llolvegat, in Catelonia, built in the early part of this century. This is the only canal of this nature which can be considered as an economical success for the proprietors who built it. The canal has a water capacity of 4,200 litres (1,092 U. S. Galls.) per second and irrigates 3,230 hectares (1,292 acres) of land besides supplying certain industrial demands. The cost of construction was about 1,500,000 francs ($300,000) and the zone supplied is within a short distance of a great center of population and the city itself is the most active in Spain for its industries. Irrigation was already practiced, but in an insufficient manner, before the construction of the canal, and consequently all the conditions here present were exceptional.

The great irrigation enterprises recently held by concessionary companies have all failed without exception, at least from a purely financial point of view; and we can cite, in the order of their inauguration, the canal companies of Urgel, l'Henarez, l'Esla and the greater number of the important irrigation reservoirs which have been constructed in recent years. Several causes have contributed to this check, felt by all the companies. Some of these are of a general nature, others depend upon particular circumstances, such as bad design or defective construction. But it can be said that the chief obstacle against which the financial interests of the concessionary companies have been wrecked is the slowness with which the cultivation of the land is developed, a slowness which is always in discord with the urgent necessity of the capital invested in such works. This slowness in the agricultural development is generally due to the want of experience, and sometimes of aptitude, in the agriculturist in changing his methods and the want of capital for a complete transformation in practice. It is also to some degree chargeable to a conservatism which makes the farmer a slave to traditional routine.

Of the limited number of great irrigation works of modern times in Spain, executed wholly or in part at the expense of the State, the imperial canals of Arragon offer the most salient and instructive characteristics for those who would wish to study the bearing of the different social entities upon the great work of irrigation.

The imperial canal of Arragon takes from the Ebre river a volume of water which varies from 35 to 15 cu. m. (1235.5 to 525 cu. ft.) per second, with the minimum in the lower service. The canal, built in 1770-1790, was commenced by a private company which was ruined by the operation, and was finished by the State with the almost exclusive end of establishing navigation between Tridela, in Navarre, and Saragossa. Irrigation was introduced sometime after the opening of the canal; and later, as the construction of railways completely modified the conditions of traffic, navigation was almost entirely abandoned and irrigation become a necessity both for the financial interests of the canal and in response to the demands from the rich country which bordered it. The expense of constructing this canal had imposed upon the public treasury an annual charge of $300,000, and the direct revenue to the State, after a century of operating, does not exceed the sum of $34,000 annually. This circumstance, however, is not as onerous for the State as it would have been for a private company under similar conditions, for the construction of this canal has really been a source of rich revenue; and, directly or indirectly, it has turned over to the public treasury a very considerable part of the benefits which come from it. In 1848, the Government having reduced to the minimum the direct use of the canal, the irrigated surface was increased by one more level and the cultivation was proportionally developed; land before fallow now gives two or three crops per year, and whereas they were previously uncultivated they are now able to support a goodly tax.

This is a striking example of the part the State is capable of taking as compared with any particular company. If the private enterprise can lead to good results it is only upon the condition that the concessionary company receive large returns upon the cost of launching the project and secure the interest and a sinking fund, to wipe out the capital employed, by the receipt of taxes imposed upon the farmers and from all who utilize the water for any purpose. Any projects which do not satisfy these conditions are unfeasible; and while the State is not able to realize all irrigation schemes, owing to the limit of its resources, we can yet affirm that they would generally be advantageous to the State; for, aside from the direct revenue to the public treasury, would be that which it receives, through the infinite paths of trade, from the products created by an increased richness of its soil.

In late years, the Government has attempted several methods of favoring the creation of new irrigation enterprises by means of different measures of encouragement introduced into the laws governing the use of water. This encouragement was the particular object of the law of July 27, 1883, which offered subventions to enterprises which contemplated the construction of canals and irrigation works of recognized public utility, provided that the quantity of water furnished for irrigation purposes was at least 200 litres (52 galls) per second. These subventions consisted; (1) Of an allowance not exceeding 30 per cent. of the estimated cost of the canal, or reservoir, and the principal lines of service; (2) of an indemnity, or security from loss, not exceeding $50 for each continuous litre of water per second that the canal or reservoir employs for irrigation. The Government is authorized by the law to substitute for the subvention a gift, which consists in the execution of special works or works of difficult execution, at its own expense and carried out under the agents of the Administration of Public Works. In no case, however, must the total of the subvention and indemnity exceed 40 per cent. of the estimate for establishing irrigation; or, including everything, 100 francs for each hectare or $50 per acre of irrigable land. The above gives the fundamental basis of the law of protection for irrigation enterprises now in effect; but no opinion can yet be formulated founded upon its working, for its introduction is too recent.

Leaving for the present the economic side of the irrigation problem, the thing next to be considered, from a practical stand point, is the quantity of water necessary, in a climate like that of Spain, for the irrigation of a certain territory. This quantity of water evidently depends upon several variable conditions, such as the amount and frequency of rains, the hygrometric condition of the air, the particular demands of each crop, the absorbing power and looseness of the soil and subsoil, the method of irrigation adopted and even the intelligence of the cultivator in the economic use of irrigation water.

Space is lacking to repeat what has been said upon this subject by the French agricultural engineers, the Count de GASPARIN, NADAULT de BUFFON, HERVÉ MANGON, BARRAL and others upon the requirements of the climate of France. But we can give the results of the experiments made by M. LLAURADO upon various crops in different parts of Spain.

In a vegetable garden on his own property, situated in the environs of Barcelona, and under unremitting culture on account of the demands of a great center of consumption, he set aside an area of ground of a clayey nature for his experiments. The extreme compactness of this soil had been modified by the use of organic manures, and for irrigation purposes he gave it an immersion of 195 milli metres (6.2 in.) of water in depth over the area, corresponding to 1.059 cu. m. per hectare (92.65 cu. ft. per acre). This water penetrated the soil to a depth of about 0.25 m. (.82 ft.); so that the relation between the depth of the sheet of water, corresponding to the volume given, and the penetration into the soil is $\frac{1}{3}\frac{9}{2}$.

On another portion of land somewhat less compact having furrows of 0.40 m. (1.3 ft.) in width separated by ridges of the same width, an irrigation of 600 cu. m. per hectare penetrated to a depth of 0.22 m. (.72ft.) in the furrows; the intermediate bands of earth remained completely dry. The relation here between

* A paper read before the Agricultural Section of the Congress at Toulouse (French Association for the Advancement of Science) by M. ANDRE LLAURADO, Chief Engineer of the forest district of Madrid and formerly Professor of the Forestry School at the Escurial. Abstracted by G. PETIT, C. E., in *Le Genie Civil*.

the depth of the irrigating sheet of water and the penetration into the soil was $\frac{1}{12}$.

The calculation of the quantities of water expended in irrigating this land gives the following figures:-From January to May, or 5 months, four waterings each month amounted to a total depth of 42 millimetres (1.68 ins.); or, a continuous supply of 0.66 litres per second per hectare, (.43 galls. per acre): for the months of June, July and August, eleven waterings were made; or a delivery of 1.81 litres per second (.21 galls. per acre). For the four remaining months of the year, five waterings each month amounted to a delivery of 0.82 litres (.21 galls.) per second. The mean delivery corresponding to one year is then 1.09 litres per second per hectare (.7 U. S. gall. per second per acre). It is proper to here remark that no account has been taken of evaporation and filtration into the trenches, for the water coming from a *noria* situated near by, the losses from the above mentioned causes were very insignificant.

According to other experiments made on the rice plantations in the basin of the Incas river, in the Province of Valencia, the quantity of water in irrigating one hectare of rice plantation amounted to 2.4 litres per second (1.56 galls. per acre per second) from May 15 to the end of October.

From observations made in different sections on the Mediterranean shore, M. LLAURADO has deduced the figures given in the following table:—

Crop.	Time of Watering	No. of Waterings	Volume of water, each watering.	
			cu. metres. per hectare.	Gallons. per acre.
Rye	March-June	3	1.000	89.07
Wheat	June-Oct.	8	1.000	89.07
Beans	" "	8	.500	44.54
Orchide	April-Oct.	18	.500	44.53
Luzerne	The year	31	1.000	89.07
Carrots	June-Feb.	8	.500	44.53
Hemp	April-July	4	1.000	89.07
Oranges	May-Oct.	16	.540	48.10

The figures obtained from the irrigated prairies of *luzerne*, in dry fodder, were as follows:—In the neighborhood of Saragossa these prairies have been under cultivation for 8 or 10 years, and 6 cuts have been made in each year, giving 15,600 kilos, (34,320 lbs.) of dry forage per hectare 0.4 acre). The first cut was made when the plant had reached a height of 1.3 ft. and 4,901 lbs. of dry forage were cut from each hectare (12,252 lbs. per acre); the four following cuts gave a little more and the last cut gave just about as much as the first.

The North River Bridge.

With a Discussion of Long Span Bridges.

We are this week enabled to continue the publication of the illustrations accompanying the paper read by Mr. GUSTAV LINDENTHAL, C. E., before the American Society of Civil Engineers on Jan. 4, 1888, on the above subject with a very full abstract of the paper itself. The paper commenced with an introduction, describing in general terms the project of a grand terminal station in the upper part of New York City (presumably between 14th and 23d street and fronting 5th Av.) for all the railroads now terminating in Jersey City. A junction road connecting with them all, is to run through a tunnel in Bergen hill, and over an iron viaduct through Hoboken to the North River bridge, thence to descend over another viaduct on the New York side to the station above mentioned. From this station underground connection can be made with the Grand Central station of the New York Central & H. R. R. R. at 42d street and 4th avenue, also with the elevated railway system existing or yet to be built.

This terminal part of the project, although it has been worked out in considerable detail (as we are informed) was not elaborated in the address, nor were any estimates of cost or revenue presented, or definite information given as to the financial backing of the project, although we are informed that that is assuming a gratifying shape. The real subject matter of the address, presented as it was from the standpoint of the engineer alone, was the constructive features of the North River bridge proper as the most commanding part of the entire project.

The discussion of long span bridges coupled with the subject, was to technically justify the details of the plan proposed and show how, by the double process of exclusion and selection, the final design for the bridge was arrived at. The introduction also mentioned the fact that a bridge with a single span over the clear width of the river was cheaper for the selected location, than a bridge with intermediate piers, assuming that such a bridge would be permitted to be built at all. The reasons given are, the extraordinary depth to rock and consequent excessive cost of larger piers, and the impracticabiltiy of using steel in the form of wire (the strongest form into which metal can be put) in a succession of spans.

The paper is in two parts and dealt mostly with typical details and typical results. The minutiae of the calculations were left for later publication.

With this introduction the author gave in Part I. a general description of the bridge followed by a description of:

1. Foundations and masonry piers for the towers.
2. Anchorages.
3. Towers.
4. Superstructure and loads.
5. Cable supports on towers.
6. Construction of details of cables.
7. Web system between cables.
8. Provision against tornados.
9. Architectural features.

And in Part II:

1. Definition of "long spans."
2. Discussion of Cantilever bridges.
3. Discussion of arch bridges in general.
4. Discussion of inverted arch bridges.
5. Temperature strains in three hinged arches.
6. Relation of end spans to middle spans in suspension bridges, with concluding remarks.

The general description of the bridge appeared in our issue of Jan. 7, and we now give a synopsis of the following matter:

1. THE FOUNDATIONS AND MASONRY PIERS FOR THE TOWERS.

The tower foundation will be carried down to rock, which on the New Jersey side can be reached by the pneumatic method; on the New York side it is too deep for it. The pneumatic caisson will have an elliptical form about 370×180 ft. with several compartments, and with the bottom edge shaped to conform to the rock, the position and dip of which is first to be accurately ascertained by soundings. The sinking of the huge caisson to a depth of about 75 ft. below high water presents no great difficulties. From a solid bed of concrete on top of the rock, the pier is to be built up with tapering outside walls and a central partition wall. The space between them to be filled with stone ballast, and coated over with concrete on top to form a uniform and even surface with the masonry.

The foundation on the New York side will in all probability be over 170 ft. below high water. The pneumatic method is here out of the question, the air pressure would reach about 85 lbs. per sq. in., and it is not likely that men could work in it for an hour and come out alive.

The method proposed for this foundation resembles that used for the Poughkeepsie bridge and for the Hawkesbury bridge in Australia; Namely, open caissons with compartments, some of which are filled with concrete or ballast for sinking, while in others clam-shell dredges can be set to work to dig out the inside material from the bottom of the sinking caisson. The shape of the rock and the corresponding caisson edge can be determined from soundings before sinking. When down on the rock the empty compartments are filled up with concrete under water up to within about 40 ft. of the surface when the regular masonry walls will be started after the water has been pumped out. The foundations, therefore, present no new problems, except for the magnitude and great cost of the operations involved. There is ample experience on hand for this work, from deep foundations built elsewhere. A proposal and guarantee from a large and responsible contractor has been received for these pier foundations.

2. ANCHORAGES.

For these the rock is very near the surface on both sides of the river. The rock is to be stepped off, dipping away in a direction from the towers to increase the adhesive resistance of the anchorage mass against sliding.

The dimensions of the anchorages are each 320 ft. long, 210 ft. high and 180 ft. wide on the base, with a mass of about 660,000 tons weight. The anchors will not be simply anchor-plates but an intricate and connected system of anchors or beams and plates, distributing the pull of the cables uniformly through the entire mass. There will be chambers and conduits for the attachments and cables connections, to make them easily accessible for painting and for inspection in every detail. About half of the mass will be solid monolethic concrete masonry, and one half will be mere stone ballast for weight. The entire mass will be faced with granite masonry showing a simple, large featured and harmonious architecture.

The six railroad tracks will run through the anchorages in tunnels 85 ft. wide and 45 ft. high, forming an imposing and grand entrance to the bridge.

3. THE TOWERS.

The largest suspension bridges built so far all have stone towers. They were considered more durable and more solid than towers of cast-iron, which was the only material that could have been used at the time of their construction.

It is a popular idea that stone towers are necessarily the strongest and best, but of course it is not entertained by engineers. I mention it merely to dispel a popular prejudice, and would point out the recent replacing of the cracked stone towers of the Niagara Suspension bridge with iron towers as indicating that the latter is by far the safer plan.

The carefully built stone towers of the Cincinnati and Brooklyn suspension bridges have been very expensive, and they are not safe against slow decay, which may overtake the stone much faster in our climate than the metal portion of the bridge, which can be protected by painting. For bridge towers 500 ft. high, wrought-iron or low steel is without question the most suitable material.

In choosing the form of towers the following conditions were sought to be obtained:

1. An imposing architectural appearance, as being the most prominent feature of the bridge.
2. Great rigidity and stability, laterally, against the pressure of a tornado and longitudinally against the frictional resistance of the expanding cables.
3. Certain and uniform distribution of pressure from the cables to the stone piers and foundations.
4. Ease and convenience of manufacture from rolled iron shapes easily obtainable without extra cost.
5. Ease and safety of erection without the use of special false works.
6. Accessibility of all parts inside and outside to inspection and painting.
7. Freedom from temperature strains.

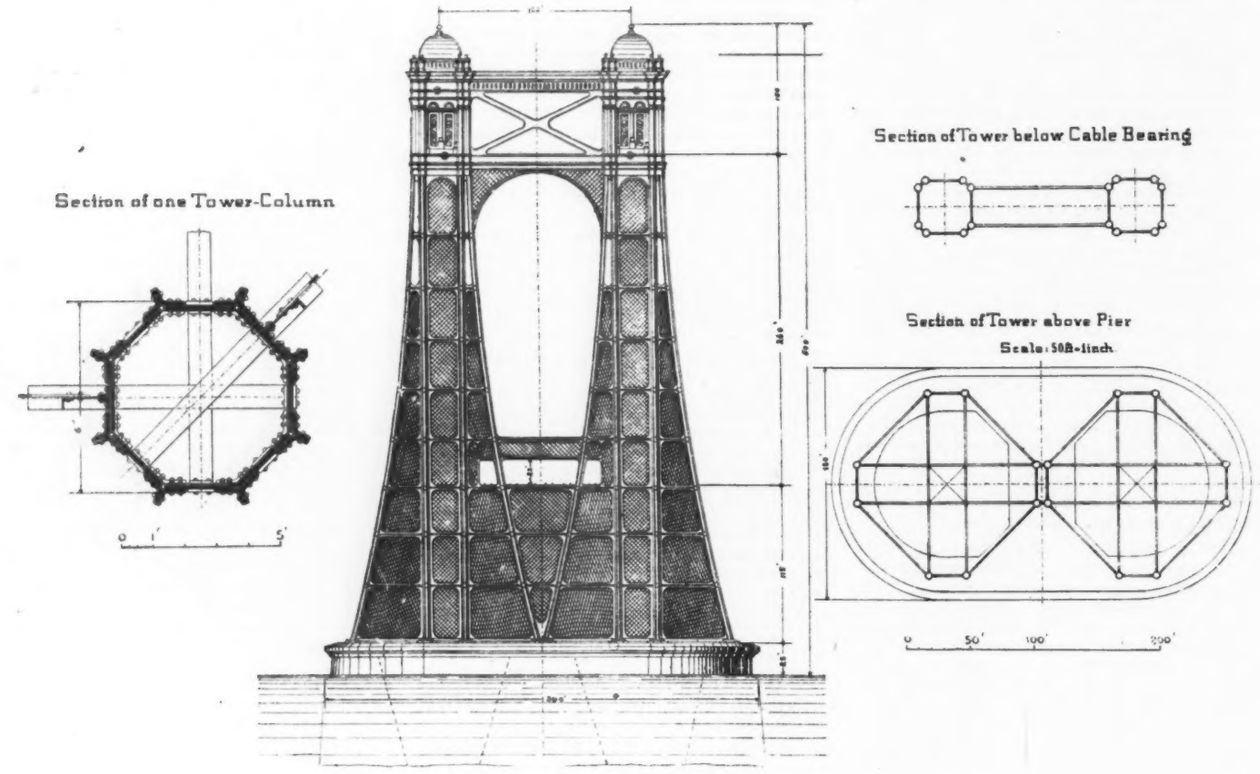
Twice eight columns, or sixteen columns for each double tower will distribute a pressure of nearly 50,000 tons on the stone piers 340×180 ft.

All of these conditions are fulfilled in the design for the towers. The eight columns are arranged in pairs at the corners (see section cut) under the cable platform on top, riveted solidly together down a double length of tiers (nearly 70 ft). The platform is so designed that the pressure on all four corners shall be alike as much as possible and descend equally from each corner through both columns. Parallel with the axis of the bridge and across it, the two columns 35 ft. apart, remain parallel. Thereby the bracing between them remains of the same width from bottom to top, and the changing lengths of outside braces are confined to the four corner faces.

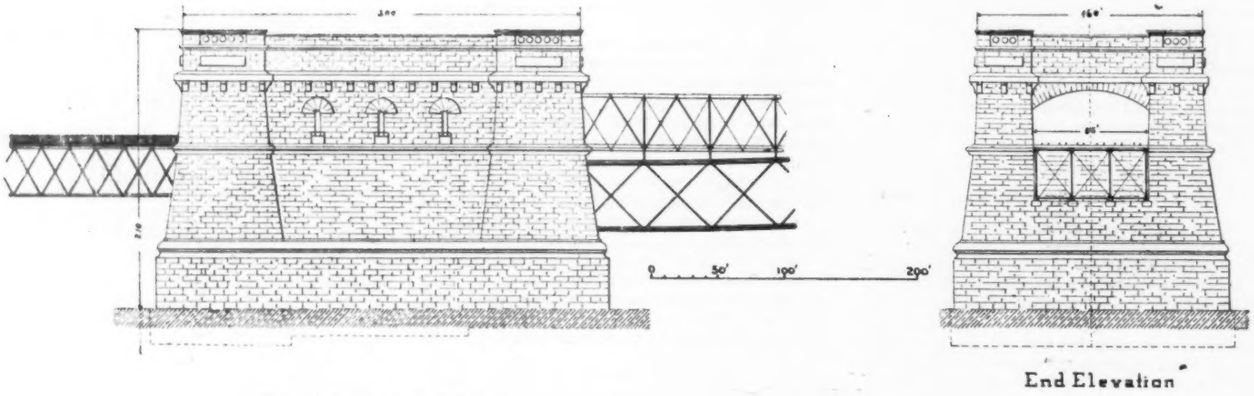
The columns curve for the double purpose of good appearance and to produce initial strains in the bracing between them, by which the rigidity of the towers is enhanced. The towers are braced together under the floor platform and between the arch supports, thereby forming a grand and lofty portal, through which the six railroad tracks pass on a platform 86 ft. wide. More tracks can be provided for on a second floor if it seems necessary.

The columns are composed of plain plates and angles, riveted together, as shown in the large scale section, gradually tapering from 7 ft. diameter at the bottom to 5 ft. diameter at the top, so that two men may easily pass each other inside one of them.

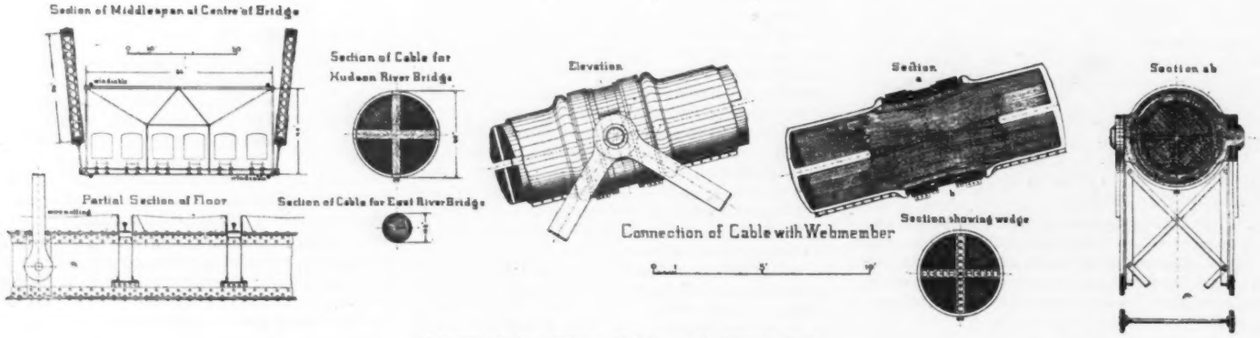
The erection can take place tier by tier, the towers forming their own falseworks, and all the material may be hoisted up inside as they grow up. The towers spread out at the base to a width of 150 ft. × 300 ft., so that the leverage longitudinally against the sliding of the cables is equal to one-third of the


Section of one Tower-Column
Section of Tower below Cable Bearing
Section of Tower above Pier
Scale: 50ft.=1inch.
0 50' 100' 200'

Elevation and Sections of Towers.



Elevations of Anchorage.


Section of Middlespan at Centre of Bridge
Section of Cable for Hudson River Bridge
Elevation
Section
Section ab
Partial Section of Floor
Section of Cable for East River Bridge
Connection of Cable with Webmember
Section showing wedge

Details of the Floor, Cables, and Connections.

The Proposed North (Hudson) River Bridge at New York.

G. LINDENTHAL, Engineer.

height, and laterally against wind to two-thirds of the height.

The wind cables, which are described more in detail below, rest against the towers below half their height, as shown in the detail section. The only wind force acting at the top of the towers (excepting the tower surface itself) is that from the arches; the balance is resisted by the wind cables along the track platform. The wind resistance of the open towers themselves is small as compared with the other, and is fully provided for also during the erection.

Temperature strains would be set up in the towers, if the columns were rigidly connected or anchored at their bases to the masonry pier. For a length of 300 ft. the movement either way from the center columns would be about 1¼ ins. and about ⅞-in. the other way, for the extremes of our climate, and if this movement could not take place, dangerous strains would be the result. The remedy provided against this is cast and turned steel ball bearings of proportionate size under all column bases (except the four on the center pier) so arranged that the columns will be anchored down to the masonry, but yet free to move according to the contraction or expansion of the strong and solid bottom braces between the columns. Each column base will be about 14 ft. square, with a bearing on the stone pier of 20 ft. square.

The bracing inside the towers will enclose a square space of about 30 ft., in which elevators and stairways can be placed for reaching the top. The construction of the bridge thus outlined is so strong, and the mass so heavy and intimately connected, that if an earthquake and tornado should destroy every building in New York City, and if it should break down the towers of the Brooklyn bridge the iron towers and the bridge they support would still stand unimpaired in their safety.

4. SUPERSTRUCTURE AND LOADS.

The arrangement of only two inverted arch trusses for a six track bridge 86 ft. wide may appear to some a bold departure from the practice for wide bridges of smaller spans. But in this case it is a carefully studied feature and one most valuable for the stability of the bridge. There appeared several great difficulties in the way, particularly in the making of cables of such huge size, before the solution seemed practicable.

These difficulties have been studied and solved, and there appears no doubt whatever, that it is emphatically the best method. Further on is a description of the method for constructing the cables, and of the connections. To mass the material and the strains into large members is one of the most important means for securing great rigidity in a structure. In a bridge with multiple railroad tracks the trusses are very rarely strained to their maximum capacity. Therefore, their safety and durability is much greater than in single track bridges. A single track bridge is strained to near its maximum every time a train goes over it. A double track only when two trains meet, and so on to a six or ten track bridge, which is strained to its maximum only when six or ten trains meet.

The longest trains which may come on the bridge over the heavy grades (maximum $2\frac{2}{10}$ per cent.) of approaches will not exceed 1500 ft. in length with the heaviest engines as double headers. If each span of the bridge is proportioned for the effects from the collectively most unfavorable position of such trains on their respective tracks, the maximum strains thus obtained will not occur perhaps once in 30 years; indeed it would be an extraordinary event six such trains should at any one time meet on such a long span. Still, this event must be provided for in the dimensioning and the construction of the bridge. The addition of four more tracks, if it should become necessary in the distant future, can be made on the upper deck, and the bridge will be built for it. All other trains and position of trains will produce effects far below this maximum, and in ordinary use for passenger trains only about 10 per cent. of the maximum effect will be of daily occurrence.

It is for this reason, that the safety of long span bridges is so much greater than for smaller spans, so that half the margin of safety of short span bridges would be sufficient to make the long span equally safe. But the intention is to strain the cables at the maximum, which may not occur in a life time, only to half the elastic limit of the metal, and the design is such, that a reversion of strains from tension to compression in any part of the cables is impossible.

The web members of the two arches are subject to the same conditions of maximum strains, and their dimensions can accordingly be made proportionately smaller than if they were divided up among four or more arches. The additional great saving of weight from this arrangement will be appreciated.

FLOOR SYSTEM.

The floor system of six tracks is shown in the large scale cross section. The floor thickness must be kept down as much as possible. Hence the floor beam is suspended at two intermediate points to a transverse truss above. These trusses are about 25 ft. apart and rest on the chords of the two longitudinal girders, which are suspended from the arches every 50 ft.

The chords of these stiffening girders are primarily proportioned for the two (top and bottom) horizontal wind trusses, to resist in combination with the four wind cables (two each at top and bottom of girders) the effects of high winds and tornadoes. The combination of the braced arch and stiffening girder is theoretically feasible, since the law and rate of deflection is the same for both, and the respective load effects would be proportionate to their respective moments of inertia, provided arch and truss have the same depth. Where the depths of arch and truss are not alike, as in this bridge, their respective work can be calculated by taking into account the different rates of deflection and the extensibility of the suspenders. The aid so rendered to the arches, however, is availed of only in the sense of reserve strength, the arches themselves being calculated for the full effects of the deforming load.

The floor beams will act as struts for the lower wind truss and the transverse truss chords for the upper wind truss. In the entire huge bridge frame there will not be (with the exception of track stringers and wind cables) one member, which at different times will not have to do double work, and still is proportioned for only one kind of duty; a most favorable combination for saving of weight in this system.

The long suspenders from the arches to the girders will be wire cables of straight wire and are wire wrapped, (diameter about 6 ins.) The floor stringers are trough-shaped, containing a rail of very heavy section on a strip of preserved timber to cushion it against impact from the wheels; and the iron trough will prevent derailments. Between the stringers and over the full width of the bridge a strong wire netting will be stretched, close enough to be walked over and strong enough to hold up a wrecked train. Wooden ties would be too heavy and clumsy a construction for such a bridge. The wire netting cannot retain rain water or snow; as a wooden tie floor does to some extent; and the wire floor also offers less resistance to wind striking the bridge from above or below.

5. CABLE SUPPORTS ON TOWERS.

We will next describe the cable supports on the towers. As pointed out before, the supports are intended to react on the cables like hinges. For this purpose the cables rest on balancing platforms, as shown in the diagram [not given this week]. When one of the cables is bearing down more than the other, it will rift or raise the lighter cable till both are reacting alike. The reaction of each cable from dead load alone will be about 7,500 tons. The huge proportions of the parts may be imagined. The friction on the pins, etc., though great, will produce a difference in the cable reactions of not more than 5 per cent. at most.

The cable sections near the towers change from round to flat to get sufficient bearing area on the saddles, the cable being flattened out in ribbon-like fashion as it reaches the towers.

The reduction of the vertical diameter is advisable for the reason, that as the cable slowly rises and falls from one season to the other the wires in the saddles should remain strained as near alike as possible.

The saddles will rest on cast-steel balls, which are preferable in this case to rollers. The least deviation from a right angle to the direction of the force is liable to greatly increase the friction on rollers, if not indeed to lock them. The saddles can move on the platform independently of their balancing action.

The horizontal lateral force, produced by the cradling of the cables will be resisted by independent braces between the corresponding saddles of both arches reaching from tower to tower. The whole will be enclosed in the large chamber 35 × 35 × 70 ft. on top of the towers and the corniced lattice bracing between them. The chambers will be water tight and secure against the weather. Every part will be easily and commodiously accessible for close inspection.

TO BE CONTINUED.

The English Iron Trade in 1887.

A report upon the English iron trade of 1887, in *The Iron and Coal Trades Review* commences with an expression of disappointment in the expectations of the early part of the year awakened by the great activity in railway building in the United States. The English market had taken into insufficient account the enormous increase in the make in the United States, which had risen from 4,044,000 tons, in 1885, and 5,684,000 tons, in 1886, to 6,400,000 tons in 1887. Germany also increased her production from 3,339,000 tons, in 1886, to an estimate of 3,840,000 tons for 1887. This latter nation now also make about 30 per cent. of "foundry" iron, as against 9 per cent. four or five years ago.

The English shipments only show an increase in the last quarter of year over those of previous year, and this increase is mainly due to a strong demand from Italy, where an 8s. per ton duty came into effect on Jan. 1, 1888. The official statement of shipments show for 1887, 78,000 tons to the United States, as against 51,000 tons in 1886, and Italy has taken 64,000 tons, against 30,000 tons in 1886. The coastwise shipments show a reduction of 26,000 tons, and trade with Russia has fallen off to very small proportions. A feature of the months of November and December has been a revival of ship-building with an estimated tonnage of 201,000 tons, as against 115,000 tons in 1886 at the same period, and 150,000 tons in 1885.

The "make" over Great Britan has increased from 6,980,000 tons, in 1886, to 7,450,000 tons in 1887; and the stock in public store, in the three iron producing regions of Cumberland, Middlesbrough and Glasgow, is 1,667,50C tons in total. Miners wages had advanced from 3s. 9d. per day, in the early part of the year, to 4s. 3d., on March 15, and a reduction follows to 3s. 11d. on July 1, at which latter figure it has since remained.

The report says it is dangerous to attempt to prophesy as to the future course of the iron market, owing to the fear of war and the agitation among the miners to reduce the output. On Dec. 30, the market closed at 43s. 9d., for Scotch; 33s. 9d., for Cleveland, and 46s. 3d. for hematite warrants.

The Action of Sea-Water on Cast-Iron Piles.

Indian Engineering notes the results of some observations made by the Chief Engineer of the B. B. C. I. Railway upon the effect of sea-water on the cast-iron piles forming the piers of the South Bassein bridge. The piles were put down in 1862; two were found almost as fresh in appearance as when sunk and showed no corrosion in specimens cut from the metal. The deepest corrosion found on any pile was $\frac{1}{32}$ in.; and this corrosion was greatest near low-water mark. The pile-bolts were all in excellent condition. All of these piles have been exposed to the action of sea-water for about 25 years, and the examination was made to set aside a current suspicion that they were deteriorating under the action of the water.

SEVERAL Master Mechanics are advising the use of four instead of six-wheeled trucks under parlor and sleeping cars. The reasons given for these recommendations are: (1) The necessity of having all the weight of the train retarded when the brakes are applied; and (2) that a decrease in hauling resistance is claimed when the wheels are reduced to four. The first is undoubted but can be met (and should be met) on six-wheeled cars. The second has a good deal of force to it. Perhaps no four-wheel truck can ever be made to ride quite as easily as a six-wheeled, but it can be made to come so near to it that the difference is not worth mentioning.

The Effect of Neglect.

JANESVILLE, WIS., Jan. 20, 1888.

EDITOR ENGINEERING NEWS:

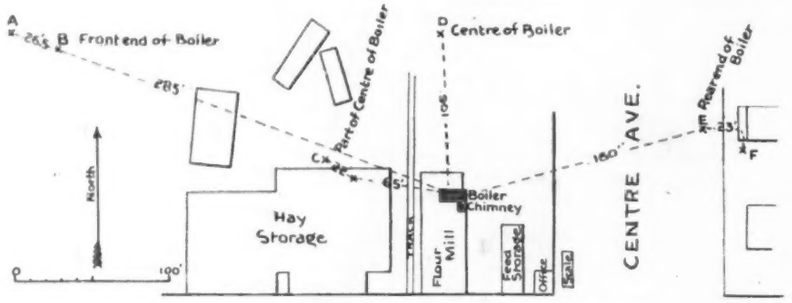
I herewith send you a tracing showing position of parts of a horizontal tubular boiler after the explosion, which occurred at or about 9.30 this morning.

The firm of Kastner and Carle operated the plant. The boiler was 12 ft. long and 42 ins. in diameter; contained 36, 3-in. tubes. Diameter of rivets ¾-in., pitch 2 ins. single riveted.

Rear end of boiler was thrown across Center Ave., striking at point *E*, bounded over the fence to front veranda of a dwelling 23 ft. then to point F, 15 ft.

The forward end went clear over telegraph wires and buildings and landed 285 ft. to the northwest, then bounded 36.5 ft. more under a newly constructed trestle work of the N. W. R. R.

The central portion of the boiler was torn along the line of rivets and a part of the same landing on top of the storage house for hay, rolled off and finally landed at point *C*. This was about one-third of the top of the middle section and had the stay-rods still riveted to it and apparently in good condition.



The Effect of Neglect.

With the above noted exception the entire middle section was thrown 106 ft. north and was very badly torn. Some parts of the fracture show anything but good metal, and the thickness of one fracture near the line of rivets was less than $\frac{1}{16}$-in. How it held together under any pressure is a mystery. There were two men in the boiler-house at the time of the accident and both were instantly killed, so no one remains to tell the tale. But from the limited inspection I made, I should say it was not necessary. The boiler house was completely demolished and bricks scattered around within a radius of 500 ft. Not a tube remained in connection with either end.

The hand-hole plates are rusted in such a manner as to lead to but one conclusion,—that they had not been removed for years.

The threads are so rusted that I doubt if they could be taken off.

Yours very truly,
J. FRANK WILLIAMS,
Constructing Engineer.

THE Austrian State Railways will introduce, on Jan. 20., a system of coupon railway tickets. They will be in the form of so-called "kilometer stamps," and be sold at a discount of 20 to 40 per cent. according to quantity. But, as is too often the case when European nations adopt American ideas, the innovation is to be hampered by conditions that will make it practically valueless to the masses. The purchasers must take not less than about $60 worth of the stamps; he must attach his photograph to the package and, worse yet, the "stamp" does not entitle the holder to a seat in the train until he has exchanged it for a regular ticket at the office.

Inside and Outside Guard-Rails.

Michigan Central R. R., Chief Engr's. Office.
DETROIT, Mich. Jan. 19, 1888.

EDITOR ENGINEERING NEWS.

I am much interested in the question of proper guard-rails for bridges, and am still on the fence. I have seen cases where cars have run safely over bridges with the trucks off the track, and the north wheels over against the south rail, and the south wheels in the air, and tipped so far up as to clear any practical height of outside guard-rail. I enclose a letter from our Superintendent of Tracks, Mr. DAILEY, relating his views on this subject. If you want to use any of it in your paper, do so. If not, use it for your own information. I am far from being convinced that the so called Latimer bridge guard has more good points than bad ones.

Yours truly, J. D. HAWKS.

[We reproduce with pleasure the very interesting letter referred to, containing a valuable summary of facts. We cannot agree entirely with the conclusions expressed, however, but have summarized both the facts and conclusions on another page.]

DEAR SIR: I noticed an article recently in regard to guard-rails for bridges, in which the writer speaks in favor of inside guard-rails. I wish to give you a history of our experience with inside guard-rails for bridges.

In 1867, J. G. RILEY, locomotive engineer on construction train of which I was conductor, conceived the idea of getting up a re-railing device to place near the end of bridges, and did at that time get up and place one on the main track 400 ft. east of the Niles bridge over the St. Joseph river in the City of Niles, Mich. Said device, which consisted of two guard-rails running from a point in the center of track to a re-railer, was substantially, and I think identically the same as the Latimer re-railing device. Within 30 days after this device had been placed, a freight train pulling out of the siding as fast as possible to get a run at the Niles hill had one truck, the forward truck of a car, off the track, but the train men did not know it. As luck or circumstances would have it, RILEY, the inventor, and myself were there, saw the train pulling out, engine at full throttle and hooked down, truck off track, bounding over the ties. We swung our hats and tried to stop the train, but all to no effect. The engineer was not looking back but ahead. We both (RILEY and myself) walked towards the re-railing device. As the truck approached, we saw that it had jumped out of the center socket, broken the center pin and crowded back nearly to the center of car. It struck the re-railing device, and "*presto*:" the change was magic. The truck was on the track in a second As the way car passed us, we motioned the conductor to stop. He set brakes and stopped the train, its full length west of the bridge; (It was a deep bridge, 600 ft. long, and 90 ft. above water); backed up, side-tracked the car that had been off the track and went west without further delay. This was encouraging for the use of bridge guards, as we then called this device, and several were ordered made in our blacksmith shops at Niles. Two were placed west of the Niles bridge, one about 50 ft. west of the other to make doubly sure at that end of the bridge. Two were placed on the Calumet drawbridge, three miles east of Kensington. One of these guards or re-railers is still on that bridge and has been there continuously since 1867, except the steel plate on the outside of the track, which wore out and was not replaced when we changed from 60-lb. rail to 65 lb. rail. No further accident ever occurred at the Niles or Calumet bridge to test these re-railing devices.

In 1877 or 1878 we placed bridge guard-rails on the inside of the rails, 7 ins. from the main track rails, and running to a point in the center of the track about 35 ft. from each end of the bridges. These guard rails were intended to force a derailed truck into line and guide it across the bridge. We placed these guards on all bridges on the main line of the Michigan Central Railway between Detroit and Kensington. *Within three years from the time we placed these guards on the bridges* FOUR *freight car trucks in four different freight trains had been off the track in crossing bridges having these guards, and* THREE *of these trucks took the wrong side of the point of guard rails.* [We italicize this statement to refer to it editorially, as illustrating the importance of the end posts and outside guards shown in the accompanying illustration.—ED.]

One was an iron girder bridge across a street in Jackson, Mich. The truck took the wrong side of the point, that is to say, the wheels that belonged on the north rail took the south side of the point, but as it was a girder bridge the car passed over without wrecking the bridge.

The next was on a wooden pile bridge east of Delhi, Mich., known as the curve bridge over the Huron river. The truck took the wrong side of the point in the center of track, lifted the truck of the next car off the track, passed over the bridge all right and went down the bank after passing the bridge.

The next and third was at Kellogg's bridge, a through truss iron bridge, 120 ft. span, over the Huron river. Through some cause unknown, the forward truck under a freight car loaded with wheat, got off the track, and the wheels that belonged on the south rail immediately worked over beyond the center of the track towards the north rail, (only one truck off the track) *ran about one-half mile* [italics ours.—ED.] to the bridge, took the wrong side of the point, and as the truck followed the point towards the north rail, careened the car, lifted the next truck ahead off the track, carried the forward end of the car far enough north so that the corner struck the end-post of the bridge, which is slanting, slipped up the post, and turned bottom side up onto the track inside the bridge. The roof gave way and the wheat fell into the river, close to the abutment. When the car fell from the slanting post, bottom side up, it imbedded itself on the rails in such a manner that the rails formed a guide for it, and the rear part of the train shoved it entirely through the bridge. After passing through the bridge, the bridge guard rails, running to a point, raised the car from its bearing on the track rails and it dodged off down the bank, clear of the track. The bridge was not damaged beyond a little bending of the end post that the car struck. So much for inside guard rails. Now I wish to explain about outside guard rails, which some roads are putting on to turn a truck that is off the track, to make it take the right side of the point of inside guard rails.

These we had on the same (Kellogg's) bridge. We put in long ties, placed a timber 7×12 ins.×35 ft. long, with the outer ends spread and the ends nearest to the bridge near enough to the track to turn a truck that has worked past the center of the gauge and make it take the right side of the center guard rail point. This guard timber was bolted through each tie with a ¾-in. bolt and faced on the inside with heavy facing steel plates 7 ins. high, ordered expressly for that purpose. When this truck, that I have explained about, got off the track, the wheels which were outside of the rails did not touch the ground at all. There were no marks outside the rails from a point where the truck had worked over to the center of the track to the bridge, but the flange of one of the outside wheels just touched the top of the outside guard and left a mark which was barely discernible. A single truck off the track will almost invariably work towards the center of the track, and if it is a truck that has a wide bearing for the car to rest on; that is, with the bearing directly over or a little outside of the wheels, such trucks will be tipped with the weight of the car on the wheels that are between the rails and the wheels that are outside the rails will be lifted clear and touch nothing. How can it be otherwise? When a truck is off the track and working towards the center, it has a lever purchase on the bottom of the car, the car being held at each end by the cars adjoining, it must necessarily careen over and throw its whole weight on the wheels that are between the rails. This causes the wheels that are outside the rails to lift and not touch the ground.

A truck having a side bearing about half way between the center pin and the wheels, will not act in this way when off the track, but will trail along

closer to the rails, for the reason that the bearings are placed between the center pin and journal bearings, instead of over or a little outside of them, consequently the outside wheel cannot lift. A center bearing truck is a safer truck both on sharp curves and on track that heaves badly in the winter. Many outside bearing trucks under freight cars jump the track on account of the bearing being outside of the wheels instead of inside.

After the accident at Kellogg's bridge, it was decided to take off the guard rails that had been placed between the main track rails, running to a point each side of the bridge, which we did, and substituted outside guard rails, running from the ends of the outside guards heretofore mentioned on all through truss bridges so that in case a truck got off the track and did not raise the outside wheels the truck would be guided in towards the track by the outside guards and be guided across the bridge. The outside guard rails were placed 7 ins. outside the main track rails on the bridge.

In case of an outside bearing truck getting off the track, and the outside wheels lifting so as to go clear of the outside guard, the wheels that are inside of the track and on which the weight of the car rests, finding no inside points, to turn them further away from their course, will go through the bridge all right, and in many cases run for miles, until they drop into a cattle guard or open culvert, or break down from pounding over the ties.

Here I will say that my experience has been, that if a car truck off the track reaches a bridge without breaking entirely down, if you let it alone, and do not try to skew it out of the course that it has taken, it will go across the bridge all right. With 15 ft., ties and a bond timber notched and bolted on to the outer ends, there is no probability of a truck breaking down on the bridge, for the reason that the ties are nearer together than track ties, and are held in place by the bond timber, and if a truck off the track reaches the bridge, it is bound to go through all right. Where two or more cars are off the track in a train, nothing will keep them from ditching themselves.

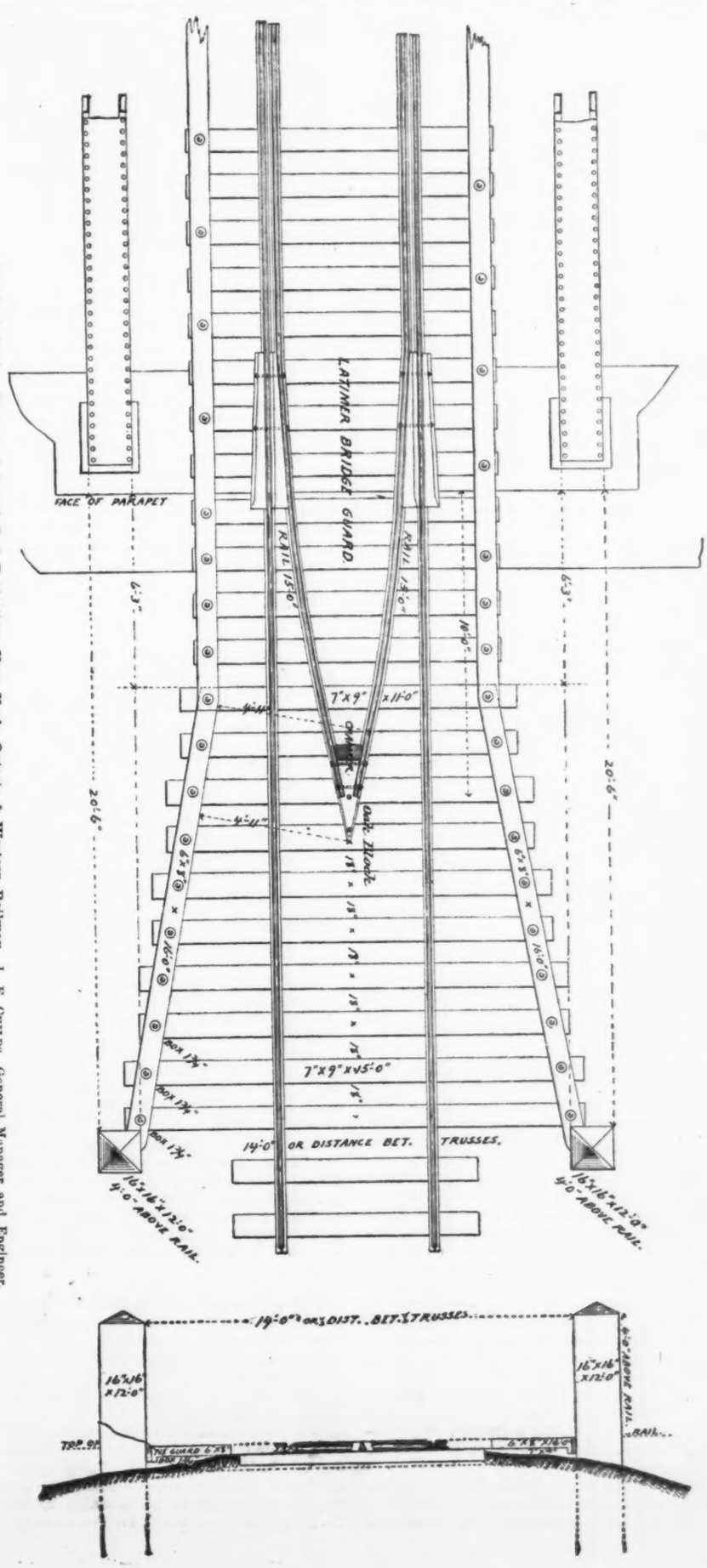
In some cases, as at the Niles bridge, the inside guard rails, with or without re-railing device, are good, but the chances are against them. They do more harm than good. If the truth of railroad men's experience could be known, the bulk of evidence, I think would be in favor of letting a truck take its course across a bridge, instead of trying to to turn it, or disturb it at the very point where it is most dangerous to do so. What hurt can it do? It cannot force the car to one side far enough to strike the side of the bridge, nor can the truck itself get foul of any part of the bridge; therefore, as I have said, let it alone, and it will pass the bridge all right. I am speaking now of a single truck off the track, and all I have said has reference to one truck off the track, except where I mentioned that if two cars or more are off the track, nothing would keep them from ditching themselves.

The objection spoken of by the Massachusetts Commissioners, that the inside guard cannot bring into line a truck which is half the gauge or more away from the rail, is just the point where the danger lies, and makes the inside guard rail a dangerous thing to use. Let the inside bridge guard rails running to a point in the center of the track, be generally adopted on all roads, and I fear that we shall soon hear of more Ashtabula wrecks. For the past five years there has been much said for and against inside bridge guard rails; some clamoring for the inside guard rails and deadly bumping post, but with the experience that I have had, I consider the inside guard rails running to a point, a *death trap*, and the bumping post theory the outgrowth of inexperience.

Yours truly, A. G. DAILEY.

[We reproduce from our issue of Feb. 12, 1887, a drawing showing these deadly bumping posts, and inside guard rails, as embodied in the standard bridge guards of the New York, Ontario & Western Railway, which we regard as the best in use and incapable of much improvement, except to place the bridge ties closer together and change somewhat the position of the collision posts and truss, as noted on our editorial page.—ED. ENG. NEWS.]

Standard Bridge Floor and Guard Rail Protection, New York, Ontario & Western Railway. J. E. CHILDS, General Manager and Engineer.



ENGINEERING NEWS

TRIBUNE BUILDING, NEW YORK.

VOL. XIX. Saturday, January 28, 1888.

D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Coming Technical Meetings.

Engineers' Club of St. Louis, Mo.—Regular meeting Feb. 1. Secy., W. H. Bryan, 703 Market St.

American Society of Civil Engineers, New York.—Regular meeting, Feb. 1. "Dam across the Potomac river for increasing the Water Supply of Washington;" by S. H. Chittenden. Sec., John Bogart, 127 E. 23d St., New York City.

Engineers' Club of Philadelphia, Pa.—Regular meeting, Feb. 4. Secy., Howard Murphy 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, Feb. 6. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Club of Cleveland, O.—Regular meeting, Feb. 14. (Mechanical Engineering branch of the club). Secy., C. O. Arney, 31 Blackstone Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting Feb. 15. Secy., S. E. Tinkham, City Hall.

American Institute of Mining Engineers.—Annual meeting at the Institute of Technology, Boston, Mass. Feb. 21 to 25 Secy., A. Raymond, Burling Slip, New York City.

American Society of Mechanical Engineers.—Meeting at Nashville, Tenn., in April or May. Secy., F. R. Hutton, 280 Broadway, New York City.

Master Car Builder's Association.—Next convention at Alexandria Bay, N. Y; commencing June 12. Secy., M. N. Forney, 45 Broadway, New York City.

American Railway Master Mechanics' Association.—Next meeting at the Thousand Islands, N. Y.; June 19. Secy., Angus Sinclair, Chicago.

THE very liberal extract from Mr. GUSTAV LINDENTHAL'S late paper on the proposed North River Bridge, which we are enabled to give this week with all the more important illustrations not already given, will be read, we are sure, with very great and general interest, not only from its intrinsic value as a study of a very great engineering problem, but as the first definite description of a work which has at least a very fair chance of becoming the greatest of its kind on this continent, or in the world.

That some such structure will be built over the North River is as certain as any event still in the future can be. The necessities of the situation, which becomes more urgent every year, can be met in no other way with anything like equal promise of success. A pair of parallel single track tunnels, like those already about one-third constructed, may be much better than nothing, but they will go but a short way toward supplying the demand for transit across the river, not to speak of terminal and other difficulties, nor of the unpopularity with passengers of tunnels as compared with bridges. The latter seems like a small point, but it has a certain very considerable pecuniary importance to Northern New Jersey at least.

As to precisely how good are the prospects of this great enterprise for early construction, we are not so well advised as to be able to express any opinion, but we believe it to have a very fair prospect of going speedily forward, and it certainly has that solid basis which was so sadly lacking in the Panama canal scheme, a well studied project to begin with. The details of the plan may, and probably will, require considerable modification, but that in its substance it is practicable at a reasonable cost for the result obtained, we take to be almost certain. Fortunately, engineering difficulties do not by any means vary in direct ratio with magnitude, as the cost does, and there seems to be little in the proposed design which previous experience does not indicate to be entirely practicable.

THE collision last week in New York bay between two first class ocean liners, neither of them running at full speed, in broad daylight, on a clear day, and with any amount of available water to keep out of each other's way in, was from one point of view due only to the grossest carelessness. There was no possible need nor excuse for any such occurrence, if the commanders were provided with only a moderate amount of foresight and presence of mind. But what the occurrence really illustrates is rather the ineradicable tendency of otherwise cautious and competent men to lose their heads completely in occasional sudden emergencies by trusting to luck a few seconds too long, and then at last doing just the wrong thing.

Two still more striking illustrations of the same tendency recently came to our knowledge. In one, during a great strike, the chief of the mechanical department of a great trunk line was officiating as switchman. He had set the switch right for an approaching train, and was standing quietly by, when of a sudden, as the train was almost upon him, the notion struck him that the switch was wrong, and he suddenly threw it wrong, the train barely escaping a serious accident in consequence. The other was at an installation of electric plant only a few months ago. A green but fairly intelligent employé was entrusted with the duty of turning a certain switch in a certain way at the word of command. He was carefully—too carefully—instructed that he must turn it to the *left*; if he turned it to the right the men handling the wires would be dead men. He was even practiced in it till he was supposed to have the simple lesson perfectly; the work proceeded; the word of command was given; he turned the switch to the *right*, and three men fell dead! His very anxiety and fear of error had been his ruin.

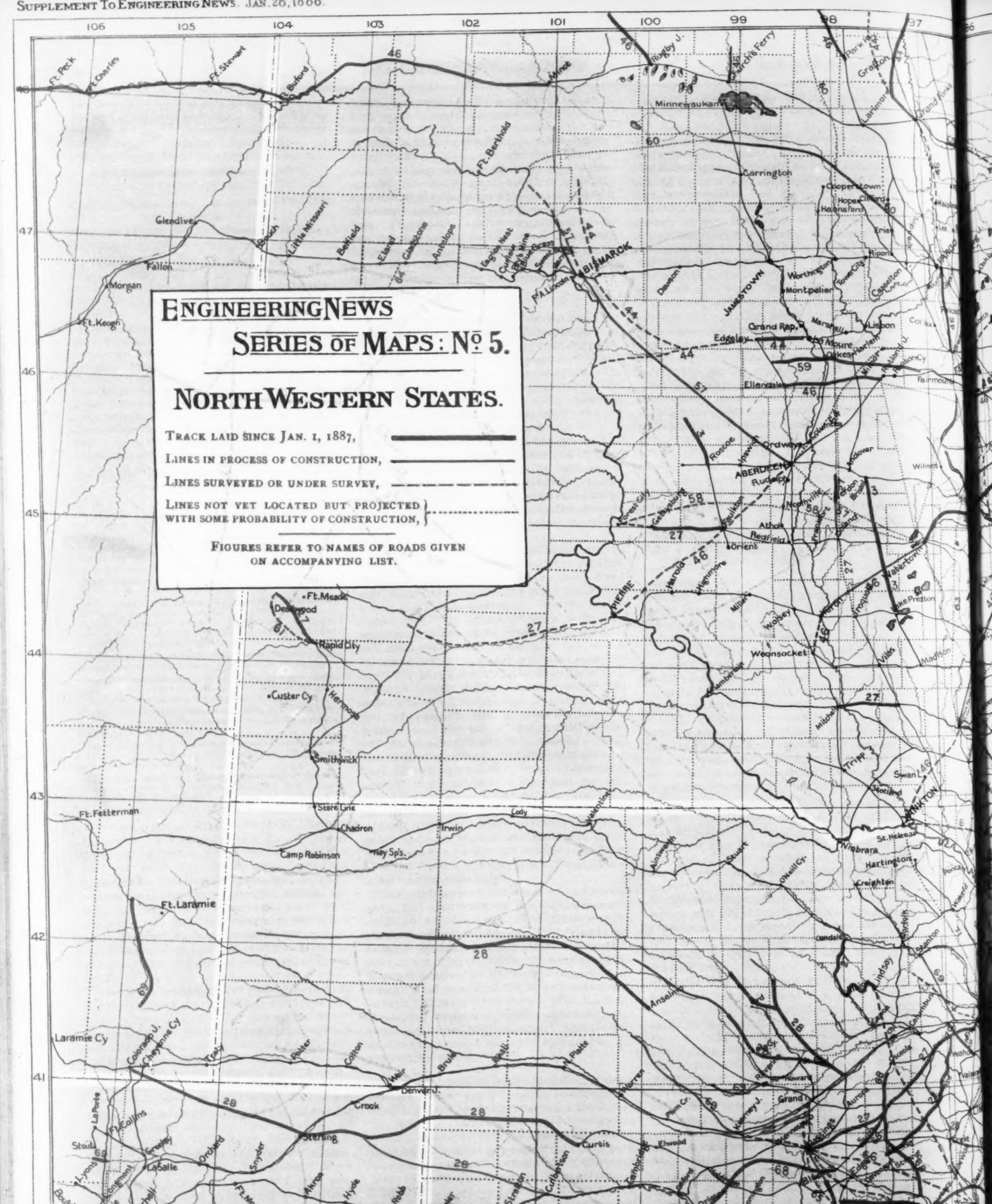
Such contingencies are in one sense unavoidable, and due only to the carelessness of employés or trespasses. The fault is often thrown on them in that way, in jury and commission findings, and all other blame withheld. But it is really as great negligence not to guard against the known weaknesses of the human mind as against the known weaknesses of rails and axles, when such appliances as interlocking apparatus, block signalling, over head crossings and automatic signals and checks of various kinds exist and are not unreasonably costly.

BOSTON passenger traffic facilities, a never ceasing subject for newspaper comment and complaint, are receiving renewed attention on the beginning of the Legislative hearings as to the elevated railroad petitions, which promise to be more protracted than last year. The same subject is being actively discussed also in Chicago, St. Paul and Philadelphia.

In Boston there are four sets of petitioners. Capt. J. V. MEIGS appears for the purpose of obtaining relief from the restrictions of the charter which the Meigs Elevated Railway Co. already have, or to ask for the passage of a general law permitting and regulating the operation of elevated railway systems in the city and to suburban points. F. A. BARTHOLOMEW, President of the Riley Elevated Railroad, wants the right to build several lines. The Mayal system, thought by some to be the coming mode of travel of the Nineteenth Century, is represented, and Mr. S. P. HINCKLEY and others ask for broad rights to construct a system of belt lines, with others radiating like spokes from the "Hub," particularly in north-easterly directions through Charlestown and Chelsea. The hearings will consume several months and no one, perhaps, be much the wiser at the end. Meanwhile President WHITNEY, of the West End Street Railroad Co., appears to be making great exertions to accommodate the travel and satisfy the public while diminishing the street obstructions. The Sprague motor for street cars appears to be shelved for the present, but on the other hand it is proposed to construct about ten miles of cable railways on the main routes of travel, during 1888. Any method appears to be better than horses for motive power economy. That elevated roads and some or all of the other methods of transportation are needed in Boston is beyond question. Fortunately it is getting to be generally recognized that it is of the first importance that great cities should have adequate means for maintaining the circulation of travel as the only alternative to stunting of growth, with its resulting indirect losses to these communities.

As to the New York rapid transit problem, it is becoming daily more serious, and is already almost as serious as that which led to the construction of the elevated roads in 1877-8, although the total passenger movement is now considerably more than double what it was then, the *increase* last year of the elevated traffic alone having been some 35,000,000 passengers, which is more than the *total* internal passenger movement of New York in 1860-62. We are accustomed to look on that era as a pretty active and civilized one, but nothing in modern times is more remarkable in its way, than the leaps and bounds by which internal city traffic now advances in all the cities of the world, but especially in this country.

Besides the Brooklyn bridge problem, as to which a report from the Board of Experts may be expected shortly, which will probably show the way to a manifold increase of the capacity of that overcrowded structure, we are promised shortly a message from Mayor HEWITT confined exclusively to the question of internal improvements, the chief topic of which will undoubtedly be rapid transit improvements. It is understood that the intention of the Mayor is to recommend the construction by the city of an underground road for four tracks, either on Broadway or on an enlarged Elm St. just east of Broadway. We are by no means clear that an underground road is a better or as good a type as a high viaduct road carried on piers standing in the middle of the blocks, *i. e.* in the back yards of the buildings fronting on the street. This would give average spans of about 260 ft., which would be very nearly the span of greatest economy under the given conditions. Still, there is much to be said for an underground line on one or two routes at least, and as either type of road, properly laid out and built, is sure to be very profitable, and as it is very desirable that the lines when built should be controlled for the public interest, and not simply for private gain, and as the city can borrow money cheaper than any company whatever, there is an obvious propriety in the works being built by the city, if proper political *and non-political* arrangements can be



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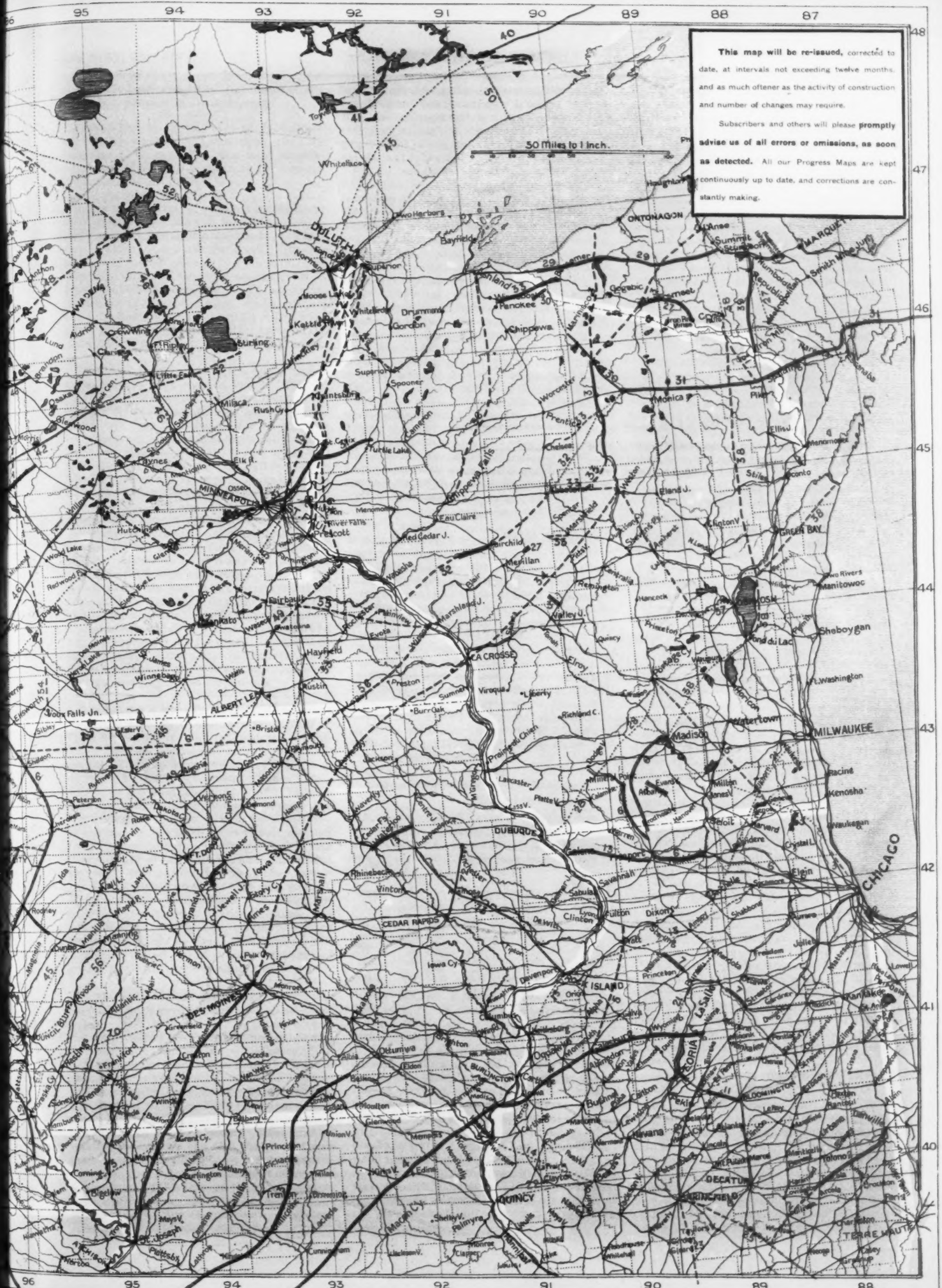

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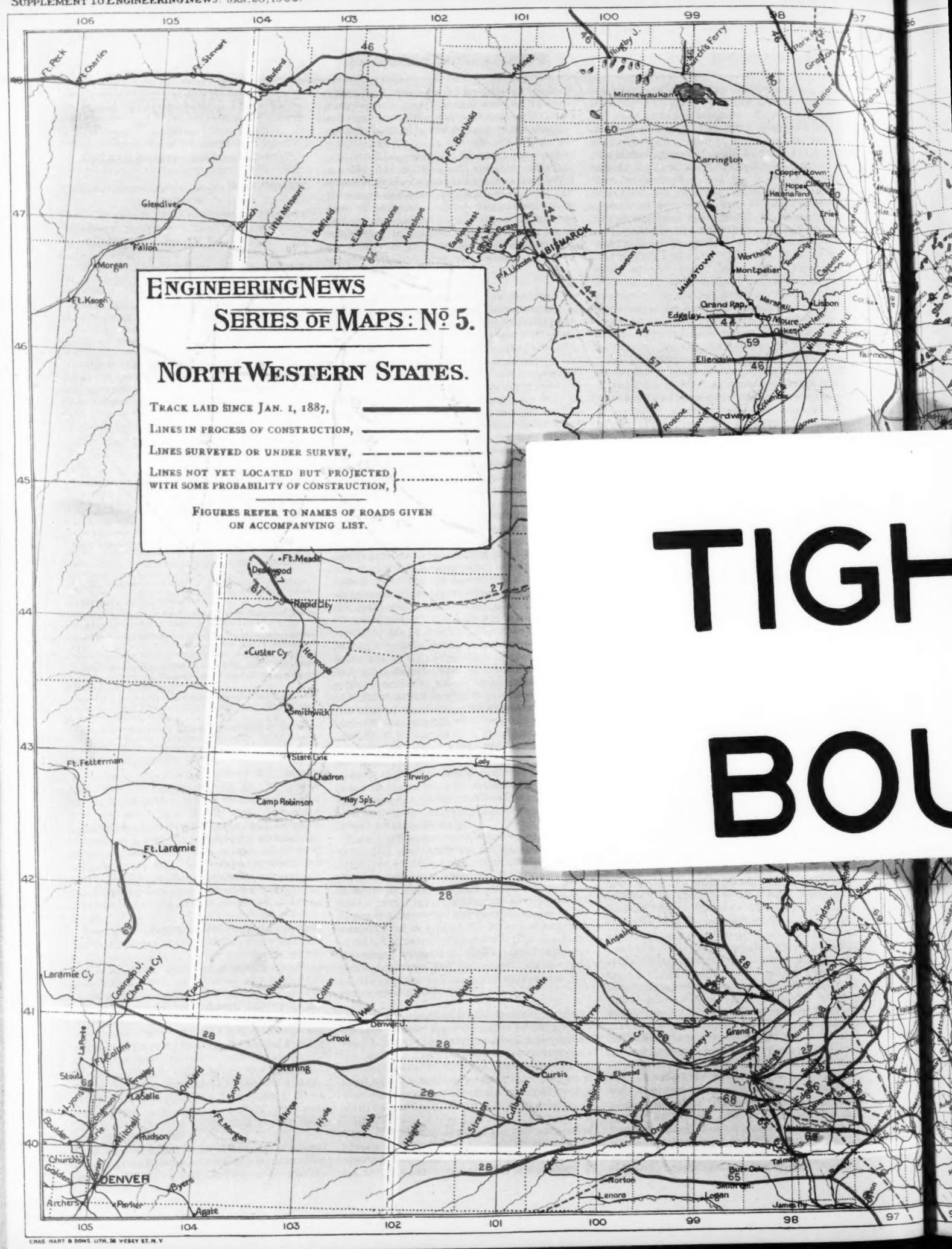
ENGINEERING NEWS
SERIES OF MAPS: No 5.
NORTH WESTERN STATES.
TRACK LAID SINCE JAN. 1, 1887,
LINES IN PROCESS OF CONSTRUCTION,
LINES SURVEYED OR UNDER SURVEY,
LINES NOT YET LOCATED BUT PROJECTED WITH SOME PROBABILITY OF CONSTRUCTION,
FIGURES REFER TO NAMES OF ROADS GIVEN ON ACCOMPANYING LIST.
BISMARCK
DENVER
Ft. Peck
Ft. Charles
Ft. Stewart
Ft. Buford
Ft. Berthold
Minnewaukan
Carrington
Jamestown
Glendive
Fallon
Morgan
Ft. Keogh
Ft. Meade
Deadwood
Rapid City
Custer Cy
Hermosa
Smithwick
Ft. Fetterman
State Line
Chadron
Irwin
Lody
Camp Robinson
Hay Sp's.
Ft. Laramie
Laramie Cy
Cheyenne Cy
Colorado J.
Denver J.
Sterling
Curtis
Elwood
Norton
Lenora
Logan
Oakdale
Ansley
Grand I.
Kearney J.
Platte R.
Burr Oak
Talmage
Table 1
Table 2
Table 3
Table 4
Table 5
Table 6
Table 7
Table 8
Table 9
Table 10
Table 11
Table 12
Table 13
Table 14
Table 15
Table 16
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Table 18
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Table

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50 Miles to 1 Inch.
DULUTH
SUPERIOR
ONTONAGON
MARQUETTE
GREEN BAY
MILWAUKEE
CHICAGO
CEDAR RAPIDS
DES MOINES
DUBUQUE
LA CROSSE
ROCK ISLAND
PEORIA
SPRINGFIELD
DECATUR
QUINCY
TERRE HAUTE
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made. We shall await the appearance of the Mayor's message with great interest.

AFTER about nineteen years of continuous service, Mr. SAMUEL G. ARTINGSTALL, the City Engineer of Chicago, has been most summarily removed from his position by the present Commissioner of Public Works. The only reason stated is that Mr. ARTINGSTALL gave a letter to an employé, discharged by the Commissioner, stating that this man was a competent engineer of pumping machinery, and had been faithful to his particular trust. This employé was foolish enough to rush into print with the letter, and the Commissioner saw fit to regard this recommendation as "an unjustifiable act of insubordination" on the part of the City Engineer, and asked its withdrawal under penalty of dismissal. Mr. ARTINGSTALL did not reply and was discharged accordingly.

THIS is the form in which the report comes to us, though it is coupled, in some Chicago papers, with rumors of "suspected frauds," for which "Mr. ARTINGSTALL may not be responsible," but they occurred, or are supposed to have occurred, under his administration. This is adding insult to what looks very much like a deep injury; and it has the further appearance of a cowardly attempt to make a reason for removing an official whose political affiliations do not suit the present authorities. While the enforced subordination of the engineering department to the political leaders of our cities is no new feature of municipal history, this seems to be a flagrant case, and the present Chicago authorities owe it to the public and to Mr. ARTINGSTALL to either tell the truth, and say that their City Engineer did not suit their particular views in regard to the administration of his office; or, to give sound and valid reasons for his dismissal, in case such should exist. A mere hint at malfeasance in office or about an office is the most cowardly form of covering up real intentions.

As showing a live interest in the subject, it is interesting to note that on one day, Jan. 18, three representative and independent organizations passed resolutions relative to the necessity of reorganizing the technical bureaus of our National Government. These bodies were the National Board of Trade, FRED K. FRALEY, President, the Shipping League and the Franklin Institute. The latter institution in the resolution passed at its annual meeting states the change in conditions during the first century of our history, and the urgent necessity for improvement upon the present promiscuous assignment of technical control. It considers a reorganization essential for economy and efficiency of administration, and concludes by urging the members of the present Congress to enact such laws as will introduce better system into all manner of public works and their administration.

A BILL has just been introduced in Congress providing for a permanent head and assistant head to the U. S. Hydrographic Office, both to be nominated by the President and confirmed by the Senate. This bill is a partial recognition of the inconveniences attending the present methods of one only of our technical bureaus. Until very recently the hydrographer in charge was detailed from the Navy for a tour of service conforming in its length to the three years prescribed by naval custom. This practice totally disregarded the fact that to fill this position as it should be filled required experience, and the longer an intelligent officer was connected with this bureau, the more valuable were his services likely to be both to the public and to the Government. Secretary WHITNEY broke in upon past custom by granting a longer detail than usual, and the result has been an infusion of new life and energy into the management, a lifting it out of old ruts and a marked development of latent possibilities in this bureau. The result of this experiment is the bill above referred to.

But it would be well for Congress to go much further and, as we have frequently said before, introduce a more perfect system into all of the technical departments of our Government. The public works of this country, whether of construction or of survey as included in the Hydrographic, Coast or Geological bureaus, have already assumed such vast proportions that pure business motives alone, in the interest of efficiency and economy, should dictate a thorough reorganization. There should be one responsible head, and this chief should have a place in the national Cabinet; and instead of a division of responsibility, that practically amounts to none at all, one well-officered department should take charge of the technical work now delegated piecemeal to the Navy, the Army, the various independent surveys, the Interior, Treasury and Post Office Departments of our Government. This is a very crude outline of such a reorganization as the conditions seem to demand, but it is for Congress to take the initiative step by discussing this matter as its importance to the public welfare warrants.

OUT of 4,410 new books published in Great Britain last year, only 115, or about 2½ per cent., were devoted to *any* of the "Arts and Sciences." Theology leads the list with 680, and Educational (583), Juvenile (439), and Novels (762,) follow. Political and Social Economy have 113. When we consider how vast a range is covered by the general expression "Arts and Sciences," it is apparent that the number of works devoted to any branch of civil or mechanical engineering must be small indeed. In this country, the total number of books published is about twice as large as in England, but the proportion for given subjects is about the same. It is not so very great an undertaking to collect in one library every important work relating to civil engineering which has ever been published.

Railroad Extension in the Northwest.

The new railroad lines completed during 1887 and now under way in the States of the Northwest, given upon the map and list which we publish with this issue, are summarized in the following table:

States.	Track laid. 1886	Track laid. 1887	Under construction.	Located and under survey.	Projects of some promise
Ill..	371	377	346	614	875
Wis.,	451	375	88	1339	394
Minn.,	492	173	322	1161	877
Dak.,	821	758	5 5	726	1033
Neb..	628	1173	429	505	429
Iowa,	431	349	137	505	655
Total.	3194	3205	1857	5050	4254

The railway mileage completed in the past year in the six Northwestern States as shown by the above table, is almost identical with the mileage built in 1886. The location of the centers of greatest activity, which are strikingly shown upon the map which accompanies this issue, is quite different, however, from that of 1886, as will appear very clearly in our general map for the whole United States, on which the 1886 and 1887 construction will both be shown in different colors. Nebraska in 1887 is far in the lead, while Minnesota, notwithstanding the great number of new lines which have been pushed with no lack of enthusiasm as far as their promoters' means would warrant, stands at the bottom of the list and has fallen off from her record in 1886, 320 miles.

The most important lines completed in the Northwest during the past year are: the extension of the Santa Fe system to Chicago from Kansas City; the Milwaukee & St. Paul's Kansas City extension; the new lines of the Chicago, St. Paul & Kansas City system to St. Joseph, Mo., and from St. Paul to Chicago; the Minneapolis Sault Ste. Marie & Atlantic and Duluth, South Shore & Atlantic lines through the north Michigan peninsula to Sault Ste. Marie; the Manitoba extension of 660 miles to Helena, Montana, the Northern Pacific line to the International boundary to meet the famous Red River Valley road; the extensive granger campaign of the Burlington system in Nebraska with the extension to Cheyenne; and the Illinois Central's extensions to Onawa, Ia., Sioux Falls, Dak., Madison and Dodgeville, Wis., and from Freeport to Chicago. Including the mileage of these extensions beyond the boundaries of the States in the above table, the foregoing lines form a total of 3,063 miles, 1,635 miles of which are within the boundaries of the above States and form thus more than half of the 3,205 miles totalized above.

Practically all of these 3,200 miles of new roads, however, have been built to extend the great systems. The St. Paul, Minneapolis & Manitoba, including the Montana Central, laid in 1887 941 miles of track, and has 381 miles under construction and 509 miles located and under survey, with such prospects of completion that it is likely the company will lay as many miles of track in 1888 as in the year past. The Burlington system has laid 705 miles of track on its lines west of the Missouri river and 227 miles are in process of construction, besides which a large amount of extension has been planned in Nebraska, Colorado and Wyoming for next season's work, though it is still too indefinite to locate upon our map. The Chicago Burlington & Northern managers are likely to go on with the Duluth extension and may do considerable work in Wisconsin.

The 488 miles of track laid by the Chicago & Northwestern, has been principally on extensions of the Fremont, Elkhorn & Missouri Valley system in eastern Nebraska. But little work was done on the Dakota Central division compared with 1886. During the coming season it is likely that the long delayed extension from Pierre, Dak., west to the Black Hills will be pushed through. Other projects, of which the frequently reported Kansas City extension is a sample, are still too uncertain to be definitely predicted. As the system has now an extent of 6,837 miles, it can afford to be conservative in regard to extensions if it chooses.

Including the Minneapolis, Sault Ste. Marie & Atlantic and the Minneapolis & Pacific as one system, they rank next in amount of work completed, having built 424 miles of road in 1887. The purpose for which the Minneapolis mill owners built the line to the Sault being accomplished, it is unlikely that many branches will be built to that line at present. The line through the Minnesota and Dakota wheat fields is likely, however, to extend farther west and build a number of branches, unless the present severe winter should permanently discourage further enterprise in blizzard stricken Dakota.

The Milwaukee system built 369 miles of road in 1887, by far the most important half of which was the 170 miles built to complete the Kansas City extension. The company's reports of earnings have not been very gratifying of late, and its stock has needed a good deal of bolstering since President MITCHELL's death. Nevertheless considerable extension has been planned for the coming season. The ore traffic in the north Michigan peninsula is

already pretty well contended for by various roads, but the St. Paul line which has been pushed up the past year 54 miles through northern Wisconsin is likely to be extended and lay claim to a further division. The "Bismarck extension" in Western Dakota will probably reach Bismarck sometime. Surveys have been made for a road from Omaha, Neb., northwest, which are generally supposed to be in this company's interest. The total of work done by the company in 1888, however, unless the present bond market should greatly improve, will probably be considerably below that done in 1887.

The 358 miles built by the Santa Fé on its Chicago extension gives the company next rank for work done in the Northwest. Properly however, it is a Southwestern system, and its work will be considered more fully in connection with our map of that section.

The once conservative Illinois Central has laid 280 miles of track the past year, principally about Freeport, Ill., and on its suddenly built extension in western Iowa. About 90 miles are nearly ready for the rails on its Freeport, Dodgeville & Northern and Chicago, Madison & Northern lines and will be finished early in the season. The company has also located 237 miles on three extensions in northern and western Iowa, has acknowledged its intention to build into Central Dakota, and is also credited with pretty definite plans for work in Nebraska and Wisconsin sufficient to probably bring up its total of work for 1888 far in advance of most of its neighbors.

Mr. A. B. STICKNEY's Chicago, St. Paul & Kansas City system was extended 216 miles in 1887. Its completion to St. Joseph, Mo., only awaits a few days of weather mild enough for the tracklaying gangs to work, and its extension from St. Joseph to Kansas City will probably be the first work of the season. If the independent stand which the company has taken in the matter of rates proves a profitable one, a good number of the very numerous extensions which its officers are said to have planned and some of which have been surveyed, are likely to be carried through.

The principal work of the Northern Pacific has been done in the territories west of the limits of our map, and the summary for that system will be given in connection with the map of the Rocky Mountain and Pacific States. The company has laid 117 miles in Northern Dakota and reports 265 miles under survey.

The St. Joseph and Grand Island system has added 174 miles of extensions in central Nebraska. The Chicago, Kansas & Nebraska, the new system of the Rock Island west of the Missouri river, has laid 141 miles of track in Southern Nebraska. The Missouri Pacific has built 68 miles in the same region.

Deducting from the above summary of tracklaying by the forgoing 12 systems the mileage laid by them outside the limits of the six Northwestern States included in the above table, we find that of the whole 3,205 miles of track laid in 1887 in the above States, 2,943 miles were built upon the 12 systems summarized above. Only 262 miles, or about 8 per cent. was built by other companies and of this nearly all was laid upon extensions of minor systems like the Wisconsin Central and the Chicago & Eastern Illinois; all of which goes to show that if we may judge the future by the past, the projectors of "new and wholly independent" roads have a dismal prospect for their enterprises. Notwithstanding all the prevailing outcry in reference to monopolies, there can be little doubt that the above fact is really one on which the general public has reason to congratulate itself. There can be no doubt that to have the financial and technical departments of our railroad building industry conducted as they are by the great corporations, is far more to the public advantage than it would be to have the enormous capital annually invested in new railway lines, wasted and stolen as it was under the old method of building "independent lines" by construction companies.

At the present time there is no dearth of predictions that the new mileage to be built during the coming year will show a great falling off over the record for 1887. But while "doubtful things are very uncertain," it does seem probable that with the considerable mileage already in process of construction, the large mileage on which surveys have been made and for which plans have been matured, and the past prosperous year which has left most of the railroad corporations likely to build extensions in a sound financial condition, railway building in the Northwest is likely to be at least fairly brisk during the season of 1888.

Inside and Outside Guard-Rails.

We give in another column a letter under the above head which is well worthy of careful perusal by all interested in the safety of trains and bridges, both for its facts and opinions. We cannot fully agree with the latter, and think they are in part in error, but they are certainly entitled to careful consideration.

First as to the facts: Mr. DAILEY gives a very interesting body of these. In 1867, a "Latimer" re-railing guard, invented by a Mr. RILEY, was placed in front of a bridge. "Within 30 days thereafter," a freight train running at a high rate of speed to take a run at a hill beyond, had a truck very badly derailed and knocked back under the center of the car. Both Mr. DAILEY and Mr. RILEY happened to be looking on. "It struck the re-railing device and *presto*, the change was magic. The truck was on the track in a second."

This certainly was a point scored for the appliance, and led to the putting in of several similar bridge guards, as has happened from the same cause on many other roads. These guards, however, re-railed no more trains, because no derailed cars went over them; unless, indeed, as happened about two years since on the N.Y. P. & O. R. R. some derailed car was re-railed without any one knowing that it had been derailed at all, except by marks on the ties. In this latter case the car ran over 1,500 ft. derailed, as was shown by marks on the ties.

In 1877-78 inside guard-rails running to a point, but without re-railing devices, (why the latter was not used does not appear) were placed on all bridges on 270 miles of the main line of the Michigan Central, with the result that we italicise in the letter: "Within three years *four* freight car trucks in four different trains were off the track in crossing bridges having these guards, and *three* of them took the wrong side of the point of the guard-rail."

Here we may stop short to recall the fact that in the circular of the Massachuetts Railroad Commission as to bridge guard-rails, published in ENGINEERING NEWS of Dec. 31, the statement occurred:

> "As long as a train holds together it is very rare for a truck to be off the track more than a few inches or a foot."

In the same issue we said as to this statement:

> "The Commission are entirely misinformed, be the authority for the statement what it may. Greater lateral departures, while yet the train holds together for a considerable distance, are extremely common, especially on frozen winter track, and we need go no further back than the Woodstock or White River disaster of last winter to find a very recent and very prominent instance of it."

In our issue of Jan. 14, we were enabled to record "Quick Confirmation" of every leading point thus taken in the Bradford disaster, and here we have still clearer evidence. The general fact that derailed wheels are often much more than half-gauge out, even in the middle of the train, may, therefore, be considered to be as well established as any similar fact often can be.

But it by no means follows that because this frequently happens that it is the rule. On the contrary it is the exception, as every experienced railroad man will admit on consideration. Especially is this true of passenger trains, which it is most important to save. Despite the fact that out of four particular derailments three of them were of this nature, an average of 500 derailments of the same kind would show something like two-thirds of them- certainly more than half—*less* than half-gauge out.

What happened in the three specified derailments, however, in which the trucks took the wrong side of the point is instructive. It was in each successive accident:

1. Car passed over without wrecking bridge, as it was a riveted girder.

2. Two cars derailed; both passed the bridge safely, and went down the bank just beyond.

3. Through truss bridge, 120 ft. span. One truck had been off for half a mile; at guard-rails, the car careened, lifting the next truck ahead off; car struck and mounted the inclined end-post of the bridge, and fell over bottom side up on the track; then fell between rails so as to be shoved by rear part of the train entirely through the bridge. At further end of bridge "the inside guard-rails running to a point, raised the car above the track rails and it dodged off down the bank, clear of the track."

The same bridge was provided likewise with outside guard-rails, arranged relatively to the inside rails in much the same way as in the engraving which we republish this week. The derailed truck was so careened, however, that its outside wheels did not touch the ground, and barely left a slight mark on the *top* of the outside guard-rails. The truck had its side-bearings a little outside the wheels, as we find is the rule on New York Central cars. It is reasonably surmised that this had something to do with the careening of the truck.

These are the facts. What are the conclusions? 1. That "inside guard-rails are good, but the chances are against them." They were taken off. 2. That outside guard-rails are not much better. 3. That the best plan of all is to have no protection at all *but* a floor of solid, well fastened 15 ft. ties; an important and commendable "but"; but to see how a slight foundation there is in the recorded experience for these sweeping conclusions, let us briefly summarize in another form the course of events in the five recorded derailments:

1. Inside guard-rails with re-railing frogs acted very effectively in a bad derailment.

2. (Not recorded in detail but the fourth of the four subsequent derailments) same conditions and result.

3. Same floor. Wheels more than half gauge out and took wrong side of point. *No supplementary outside guard-rails.* No wreck of bridge.

4. Same conditions and result in all respects, but guard-rails or some other cause held *two* derailed cars so that they passed over the bridge all right, but "went down the bank *after* passing the bridge."

5. Same conditions but with outside guard-rails also. Truck careened so as to mount and pass over them. Inside guard-rails, running to a point raised inverted car body from track

after passing the bridge safely, and "dodged it down the bank clear of the track."

Surely this is a small foundation of fact for such large-sized conclusions. The inside guards with re-railing frogs were thoroughly effective twice, partially effective twice, and failed presumably only because not supplemented by outside guard-rails twice. The outside guards were only in use once, and failed to perform their function only because the wheels were careened high in air, a result which we do not hesitate to say is extremely rare, even with a defect of car construction which happens to be standard on the New York Central lines, but is *not* the usual practice. Mentioning only two prominent roads which occur to us, both the Pennsylvania and West Shore roads have their truck side-bearings well inside the wheels.

To the extent that the jumping of the outside guards was due to this last cause, it is a defect of car construction and not of the guard rail system, and should be corrected in the car without meddling with the guard rails. Even when it exists, however, the careening force acts with so small a leverage that gravity will and does usually keep the wheels only too close to the ground. It would as a rule be beneficial rather than otherwise if the outer wheels when they left the ties were carrying no weight, but that rarely happens.

Therefore the only evidence against outside guard-rails is the negative evidence that *in one case* they failed to act. Such negative evidence must exist against any device, for it is not likely that any safety appliance whatever will ever be invented which will always be effective. If they are *sometimes* effective and never or rarely injurious it is all that can be asked.

The inside guard-rails and re-railing frogs had precisely this effect. They acted perfectly except when wheels were over half-gauge out, which is the exception; and even then were partially useful, and did harm only because not properly supplemented. Hence the clear moral is, not to omit the inside guards, but to add the outside guards also. The cost is so trifling a matter that it should not be allowed to weigh.

As to the omission of all guards, a sufficient answer is that in four out of five of these accidents they were more or less useful, and that their partial failure in three out of five instances was due only to the guard-rail system being incomplete. With a little trouble a list of hundreds of important instances could be compiled in which even imperfect systems of guard-rails have proved the salvation of trains and bridges, as in the last great accident at Bradford, while we defy anyone to produce a single instance in which a *properly constructed* guard-rail system has proved injurious. Even in instance No. 5 above, where the outer guard was jumped, the guard-rails on the whole did good. Except for them, there is strong probability that the truss would have been hit on the side and collapsed. The burden of evidence is so overwhelmingly in favor of guard-rails in some form that it is amazing to find their total abolition urged by practical railroad men. Nor is it at all true that their usefulness is confined to one car off the track. Especially at the rear of the train there may be several derailed cars taken care of, and there are instances in plenty to prove it.

Finally, as to the usefulness of collision posts, we find in the excellent report of the Massachusetts Railroad Commission, just received, which we shall notice more fully later, this comment on them, which we answer by three interpolated sentences, to fully understand which reference is necessary to the drawing in another column, showing the relative position of post and bridge truss.

"The object of these posts seems to be to stop a derailed locomotive or car and prevent it from going to the bridge at all. [It is also to snap the coupling and save the head of the train at least.] If the post should succeed in stopping the car there would certainly be a very bad smash-up. [True, but it will be on the solid and not on the bridge, which will otherwise *certainly* be hit.] If the derailed car should strike the post on its side, and should pass by it, the presence of the post, instead of doing good, might even twist the car round so that it would be *more likely* to strike the trusses. [It is *sure* to strike them any way, and the twisting is only anticipated by a few feet, so that it may occur on the solid instead of on the bridge.] The Board believe it safer to attempt to guide a derailed car over the bridge than attempt to stop it suddenly just before it reaches the bridge. [The last is not attempted until the first has become impossible.]

In one respect only does the plan we illustrate elsewhere fail in this last respect. The *body* of the car will strike the collision post before the wheels can strike the outer guard-rail. It would be better, therefore, either that the posts should be spread further apart, or that they should be located nearly opposite the point of the inner guards by moving all the rest of the whole guard-rail system forward 10 or 15 ft., letting the posts stand where they do. It costs no more, of course, to put the system as a whole in one place than another except for the few feet more of the bridge guard-rails, while such a change gives the car *every* possible chance for its life, and only kills it by the easiest death as a last resort.

CORRESPONDENCE.

Fiber Strain in Pins.

Washington University, Dept. Civ. Eng.
ST. LOUIS, Mo., Jan. 17, 1888.

EDITOR ENGINEERING NEWS:

In your issue of the 14th inst. appears a communication from Mr. C. E. FOWLER, on the subject of fiber strains in pins, and the reader is left to infer that this is a subject which does not submit to accurate computation. It is the writer's belief that a pin can be computed as accurately as any other part of a bridge. It is only within a few years, however, that they have been correctly computed, the almost universal practice in the matter of arrangement of members being the worst possible.

If the members be properly assembled on a pin, neither the bending moment nor the shear will be material, since the size of the pin would then be proportioned to develop the full strength of the eye-bar, and this would always give a much larger pin than would be required for either bending moment or shear. If the worst arrangement be chosen, however, as is generally done, then it is necessary to dimension the pin to resist bending moment.

In Figs. 1, 2 and 3, are shown three ways of assembling eye-bars on a pin. In the first two cases we have 10 bars, of the same size, in each direction. In Fig. 3 we have 10 bars in one direction, and 11 in the other, the two outside bars being half the thickness of the others. All the three arrangements are properly balanced. The first arrangement is the most common, but it gives a bending moment as many times greater than the second arrangement as there are pairs of bars on one end. In this case we have five pairs on each end, and so the bending moment is five times as much in the first arrangement as in the second. In all probability this was the arrangement in the case cited by Mr. FOWLER, and one of the referees computed it correctly, and the other did not.

In Fig. 1 the bending moment at the center is the sum of the moments of a series of (five) couples. Thus bars 1 and 2 make a couple, the moment of which is the stress in one of them into the distance between their bearing centers, in this case the thickness of the bars. But bars 3 and 4 make another couple, giving a moment in this same direction, and so on till the middle is reached, where the moment is the sum of the five couples on one side.

In Fig. 2 the couple coming from bars 1 and 2 is neutralized by the couple formed by the bars 3 and 4, so that by the time we have reached that point in the pin between bars 4 and 5 there is no bending moment whatever. Then bars 5 and 6 cause a moment which is again neutralized by bars 7 and 8, and so on The maximum bending moment in this case is that due to one couple. By similar reasoning it may be shown that the maximum bending moment in the third arrangement is three-fourths of the maximum in the second case. All this is shown graphically in Figs. 1*a*, 2*a*, 3*a*. The broken lines are bending moment diagrams corresponding to the force polygons on the right. The vertical ordinates intercepted between the broken and horizontal lines, taken to the scale of the drawing, multiplied by the pole distance *o P*, in the force polygon taken to the scale of loads gives the bending moment at that section. The accumulation of bending moment in the first arrangement in here shown in a very striking manner, as well as the superiority of the other two arrangements

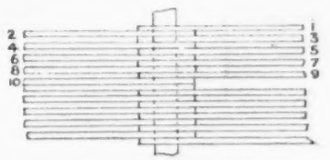


Fig. 1

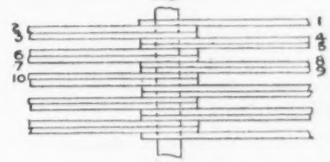


Fig. 2

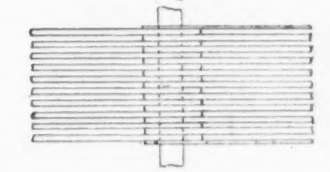


Fig. 3

Where the first arrangement is used, the bendin moment in the pin will usually give a fiber stress much greater than the material can resist, and yet it does not break. Thus in Mr. FOWLER'S case, the 100,000 lbs. fiber stress was probably correct, and yet the bridge stands. How can this be? The explanation is simple.

In the first place, when *solid sections* are sub

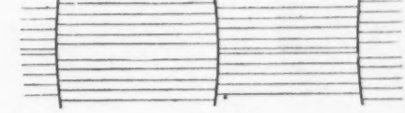


Fig. 4

jected to bending *beyond their elastic limits*, the fiber stresses are no longer uniformly varying across the section, the internal fibers carrying more, and the external fibers less than the completed amount. This variation from the assumed law of uniformly varying stress increases with the load, until rupture occurs, where for the given moment of resistance, which must have equalled the bending moment due to the external forces, and on the assumption that the stress *varied uniformly* across the section up to rupture, the *computed* stress on the external fibers will usually be about 1.7 times the tensional strength of these fibers for solid round sections.* Thus if the pin is made of 60,000 lb. material, it will carry a load giving a bending moment such as will show a *computed* fiber stress of some 102,000 lbs per sq. in. But this is a well known property of metals, so that for *solid sections*, we usually say that the cross-breaking modulus of rupture is about 1¾ that in tension. For cast-iron this ratio is about 2¼. For a rolled I-beam the cross-breaking modulus will be somewhat greater than the tension modulus, perhaps about 25% greater.

But there is another reason why Mr. FOWLER'S bridge stands, and that is because the pin really does not have to carry the bending moment which it is *supposed* to carry.

Let us assume the arrangement shown in Fig. 1,

*See Baker's Beams, Columns and Arches, pp. 35, and 57, for wrought-iron and steel respectively.

and extend it to the adjacent pins, we would then have some such result as shown in Fig. 4.

It is evident that the pins will bend as shown, but as soon as they have bent appreciably the inner bars in the panel AB, and the outer ones in the panel BC, are relieved of a part of their load, and the outer bars in AB, and the inner bars in BC, have their loads increased. Thus, the more the pins bend the more the bending moment comes short of the moment assumed in the analysis, and the more the pin fails to do its duty in equalizing the stress in the chord members. Thus the pin saves itself from rupture only at the expense of the eyebars, some of which are doing little or no service, while others are probably stressed up to twice their working limits. Because the pin does not break, therefore, is no sign that it is large enough or that the computor made a mistake when he figured its fiber stress at 100,000 lbs. per sq. in.

J. B. JOHNSON.

Stone Crusher Wanted.

Office of City Engineer.

AUGUSTA, GA., Jan. 11th, 1888.

EDITOR ENGINEERING NEWS:

We want to purchase a *Stone Crusher*. Please furnish me with the names of some parties who manufacture them. I see only *one* advertisement of this kind in your paper and I have written them.

Yours truly,

A. H. DAVIDSON, *City Engineer.*

[The best we can do is to advise the purchaser of the machine advertised in this paper. There probably is not a better one in the market. In the file of 1886 ENGINEERING NEWS is to be found another excellent machine. We really are not sufficiently interested in non-advertisers to remember who they are. It is a case of "you roll my log and I'll roll yours."

BUS. MAN. ENG. NEWS.]

New Method of Base-Line Measurement.

BLACK RIVER FALLS, Wis., Jan. 10, 1888.

EDITOR ENGINEERING NEWS:

When an engineer comes to the practical work of measuring a base line, where considerable accuracy is required, he often finds that his fine theories about the catenary, etc., are literally thrown to the "four-winds." That is, in many localities, it is practically impossible to get weather calm enough so that the wind pressure on the tape will be such as to make it possible to make a proper allowance for sag. Having been confronted with this difficulty for some time, I devised a new method, which may be of use to other engineers, and I therefore send you this description of the method employed:

The base was first staked out with a level and transit, setting all stakes possible on a level, and introducing grades where this was not possible. Stakes were placed about 15 ft. apart, and those coming at the end of the tape, or at measurement points, were made longer and driven firmer than the others, in each of these larger stakes a tack was driven and a line made in the head of it with a sharp knife at right angles to the base-line. A box was built whose length was a little less than that of the tape, and about 3 ins. in cross section. This box was placed between the first two large stakes and on the small ones, in such a manner so as to allow the tape when run through the box, to lie in an exact straight line between the two large stakes. The exact distance between the lines marked on the head of the tacks in these stakes was then read twice from both ends of the tape, so as to get a double check on the work. A thermometer was placed inside of the box and the temperature noted at the completion of the measurement of each 100 ft. of the work. After the first 100 ft. was taken the box was lifted and carried forward far enough to place it between the next two stakes, and this distance taken the same as the first; and so on to the end of the base. A constant pressure of 12 lbs. was put on the tape by hooking a spring balance into the ring at one end of the tape. The total length of the tape was not used on account of the ring being part of the length of the tape. It was also found to be a great saving of time to set the stakes at random, rather than set them exactly 100 ft. apart.

The absolute length of the tape was afterwards determined (for the above pressure) by comparing it with one whose length was known. Its coefficient of expansion was determined by measuring the distance between two fixed points at different temperatures. It is usually safe to assume this to be .000006 of the length of an ordinary steel tape for 1° of F.

All that now remained to do was to reduce the separate distance for temperature and grade, and add them up.

I secured an accuracy of 1 in 300,000 with one of Chesterman's tapes on a base of about 5,800 ft. by this method.

The greatest gain over other methods was that I could measure my line when I got ready; I also avoided *all* effect of wind and was reasonably sure of my temperature, the troublesome catenary was also thrown out altogether.

Yours respectfully, A. S. COOPER.

[This seems to be a simple and efficient method of overcoming the difficulties mentioned for ordinary work. A somewhat similar but much more elaborate system of troughs has long been used in connection with Coast Survey base lines.—ED. ENG. NEWS].

Re-railing Bridge Guards.

St. Louis Bridge & Tunnel Railroad.

ST. LOUIS, Jan. 10, 1888.

EDITOR ENGINEERING NEWS:

Referring to the editorial on bridge guard-rails in your issue of Dec. 31, will you allow me to say that a re-railing device similar to the Latimer was used on the Troy & Greenfield R. R., and Hoosac Tunnel, in Massachusetts, at the time that road was under State control. Whether it is now used since the road has passed under the control of the Fitchburg R. R. I cannot say. The first application of the device on that road was made in 1880, the Braytownite bridge being equipped with it, and its utility was practically demonstrated in a very short time after by replacing the derailed trucks of a freight car in a train. The device was adopted as a part of the standard track of the T. & G. R. R. and I am quite sure that all the principal bridges on the road were equipped with it; but as I left the road in 1882, I cannot speak positively on that point.

Respectfully N. W. EAYRS.
Asst. Supt. of Structure.

[It was so very similar to the Latimer guard that it was identical with it, although it may not have been known by that name on the road.—EE. ENG. NEWS].

The Commercial Situation.

Gen. SAMUEL THOMAS says: "Reports from our Southern roads show increased earnings, and we are hopeful that notwithstanding the gloomy predictions of some, gross earnings will be fully sustained. Railroad building will not be carried on this year to the extent it was last year, but contracts for extensions to meet the demands of business centers will perhaps carry this year's mileage up to 6,000 miles. It has been demonstrated that the growth of the country is so rapid that the general consumption of iron, steel and other manufactured products will very nearly supply the deficiency of business caused by decrease in railroad construction. If Congress does nothing more than provide for the surplus in the Treasury and we are favored with average crops, this year will be fully an average business year in all channels of trade. The fact that for the past six months business has been depressed under the expectation that some disaster was to happen, but which has not happened, will create a reaction that will induce trading, buying and the general operations that go to make up the transactions of a busy community. My information from the iron and steel mills and from the coal regions of the West indicate as many orders and at as good prices as prevailed last year. Most business men that I meet from the West ask me with surprise why we expect some trade disturbance when the general business of the country is so good and apparently promises so well for the future."

Indurated Wood Pulp Pipe.

The American Indurated Fibre Co., of Mechanicsville, N. Y., have a most useful invention in their process of manufacturing seamless wood fibre piping and tubing. Mr. H. J. MEDBERY, the president of the company and inventor, claims that it is impervious to acids and moisture, is an absolutely waterproof non-conductor and is practically indestructable. Under test the product will withstand a pressure of from 100 to 200 lbs. per sq. in. according to diameter, and it possesses a tensile strength of over 1,100 lbs. to the sq. in.

These qualities would seem to make it especially applicable to use as a conductor of water, electricity, natural gas or petroleum; and for buckets, basins, etc., we believe it is already largely in use.

As at present made the indurated pipe is turned out in 5 ft. lengths only, but these sections are united to each other by standard wrought-iron pipe-thread in such manner as to make a perfect, strong, and water and gas tight joint. The pipe is made from a specially prepared wood-pulp thoroughly washed of all sap and gum. In the pulpy state it is forced into a rubber bag having a brass strainer or form in its center which fixes the diameter of the pipe to be made. The rubber bag containing the pulp and strainer are then put into an iron tube and hydraulic pressure is applied to the outside of the bag; the pulp is thus compressed and the water forced out through the perforations in the center pipe, and in 10 minutes the fibre covering is reduced to a thickness of about ¾in. The pipe thus made is then thoroughly saturated with a composition containing a large percentage of asphaltum, and it is finally baked in special kilns. The pipe is then trimmed in a machine and threaded.

PERFORATED IRON MASTS.—In the course of the late official inquiry into the loss of the sailing ship *Æthelstan*, there came to light a source of unexpected danger in coal-laden craft. The vessel had a cargo of this sort on board, and, spontaneous combustion having taken place, all the efforts of the crew were unavailing to save her from destruction. But it surprised the master and chief mate greatly to see flames issuing from the heads of the fore and main masts when the conflagration was still confined below deck. How could this happen? The masts, being made of iron, were, of course, uninflammable, and the fire could not therefore run up them as it sometimes does in the case of wooden spars. But the apparent mystery was easily explainable; the lower masts were not only hollow, but had a number of perforations below deck for ventilating purposes. Consequently, when the cargo took fire, the heated air rushed up these tubes, causing almost as thorough a draught as the chimney of a furnace; and with the air went, no doubt, a considerable volume of ignited gas. Thus, in the very endeavor to guard against spontaneous combustion by improving the ventilation of the hold, our maritime architects have created a new peril. Now, however, that their attention has been drawn to the matter, their ingenuity will, no doubt, prove equal to the occasion. It would not be very difficult, we should imagine, to devise some means of opening and closing the ventilating holes at will. Were this done the master could have them hermetically sealed at the first alarm of fire, thus cutting off the up-draught in a moment.—*Globe*

THE Liberty Hill tunnel, on the Cleveland & Marietta R. R., was "holed" on Jan. 19. This tunnel is 1,600 ft. long, 16 ft. wide and 21 ft. high. It was commenced in April, 1887, by Mc Arthur Bros., contractors of Chicago. CHARLES L. GOULD was Chief Engineer.

A letter from San Juan del Sur, of Jan. 23, says that all the members of the Nicaragua Canal survey expedition are well. About 10 miles of the canal have been surveyed of the 40 miles requiring location.

THE New Jersey Legislature has asked the Navy Department to appoint Lieut. G. C. HANUS, U. S. N., as the Commissioner for that State in determining the boundary line between New Jersey and New York.

Dimensions of Standard Car Coupler.

A circular has been issued by the special committee of the Executive Committee of the Master Car Builders' Association on "Automatic Freight Car Couplers," giving the enclosed cut, and stating:

The Committee desires to have the opinion of the members of the Association upon the following matters.

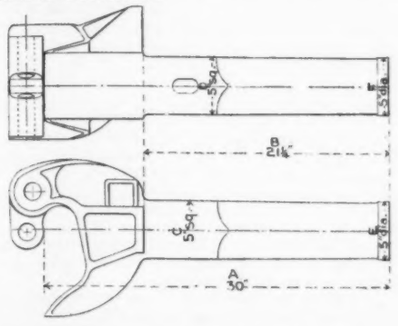
First.—The length of the drawhead from the end which bears against the follower plate to the inside face of hook when closed; marked *A* in the engraving.

Second.—The length of drawhead from the end which bears against the follower plate to the face of the horn for striking against end sill; marked *B* in the engraving.

Third.—The dimensions of drawhead in cross section at the stirrup which carries it; marked *C* and *D* in the engraving.

Fourth.—The dimensions in cross section at the end which bears against the follower plate; marked *E* and *F* in the engraving.

The cuts herewith show the dimensions indicated on the latest Janney freight car coupler, and inasmuch as other freight car couplers have been made with but slight variations on these dimensions and especially as it is desirable to have a pretty long shank for the drawhead, in order to balance the weight at the outer end, it is the opinion of the Committee that the dimensions as shown on this cut are desirable dimensions to establish as a standard.



The Committee takes this opportunity to call your attention to a further recommendation, not with a view to secure an immediate action, but to enable the members of the Association to be prepared to discuss and vote upon it at the next Convention. They consider that dead-blocks should be used with the Master Car-Builders' standard coupler. If the dimensions shown on the postal card are adopted, the dead-blocks should be 9 ins. long, measuring lengthwise of the car, and the draft springs have 2 ins. action.

The dead-blocks can be placed 22 ins. between centers as provided by the standard of the Association, provided that the lower face is not less than 38 ins. from top of rail when car is empty. As the standard for this height is given at 36 ins. by the Association, your Committee recommends that this figure be increased to 38 ins. to allow proper clearance for the new form of coupler.

EDW'D. B. WALL.
JNO. W. CLOUD.
M. N. FORNEY, *Secretary.*

PERSONAL.

J. R. & F. K. BAXTER, Engineers, 2 Bleecker street, Utica, N. Y., are the engineers for the new water-works to be built at Herkimer, N. Y.

BRADFORD DUNHAM, formerly General Manager of the Baltimore & Ohio R. R., and later General Superintendent of the Capital City Street Ry., at Montgomery, Ala., has been elected Vice-President and General Manager of the new Montgomery Southern R. R.

JAMES DONAHUE has been appointed Superintendent of the Des Moines & Kansas City R. R. (formerly the Des Moines, Osceola & Southern R. R.) with headquarters at Des Moines, Ia.

RICH. MOTT died Jan. 21 at Toledo, O., at the age of 84. He was actively engaged in railroad building in 1836, and constructed that part of the Michigan Southern R. R. between Toledo and Adrian, the first railroad built west of Utica, N. Y.

R. E. BRIGGS has been appointed Chief Engineer of the Denver & Rio Grande Railroad Company, with charge of the engineering and construction of new lines, and a general supervision of maintenance of way.

A. W. ROBINSON, formerly private secretary to Major J. M. EDWARDS, of the Mississippi Valley R. R. has been appointed Superintendent of the West Feliciana R. R., with headquarters at Woodville, Miss.

J. M. EGAN, General Superintendent of the St. Paul, Minneapolis & Manitoba R. R., has been appointed General Manager of the Chicago, St. Paul & Kansas City.

J. B. GREEN, of the St. Louis, Iron Mountain & Southern R. R., has been promoted to be Division Superintendent, with headquarters at Little Rock, Ark., to succeed FRANK HUFSMITH, who has resigned to go to the St. Louis, Arkansas, & Texas R. R.

LINDSAY, PARVIN & Co., of Philadelphia, Pa., Iron and Steel Commission Merchants, and dealers in rails, cars, pipe, etc., have moved into new offices in the Bullitt Building, 133 South Fourth street, Philadelphia.

The copartnership of WILSON BROTHERS & Co., of Philadelphia Pa., expired by limitation on Dec. 31, 1887. On Jan. 3, 1888, a new partnership was formed under the same title as above with the following members:—JOHN A. WILSON, JOSEPH M. WILSON, HENRY W. WILSON, CHARLES G. DARRACH and HENRY A. MACOMB. They will transact a general business as Civil and Hydraulic Engineers and Architects.

JOHN W. FERGUSON has resigned his position as Assistant Engineer on the New York, Lake Erie & Western R. R., on which road he has been employed for the past 10 years, to accept an engagement with Bernard Kelly & Son, dock and bridge builders, of New York City. He has been retained by the N. Y., L. E. & W. R. R. Co. to complete the work of renewing the drawbridge over the Hackensack river on the main line.

Sir ROBERT RAWLINSON has been made a K. C. B. (Knight Commander of the Bath) on his retirement from the office of Chief Engineering Inspector of the Local Government Board. He was previously a C. B., or Companion. While these dignities are little appreciated and less understood on this side of the Atlantic, they are highly prized in England, and it is pleasant to see an eminent engineer so honored. Compared with his forty years of continuous service as a public official, always energetic and faithful, the reward seems meagre enough.

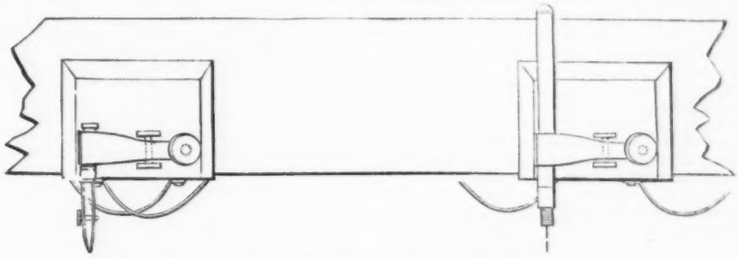
JOHN A. BAILEY died at Marquette, Mich., Jan. 22, aged 69. He became a Government engineer in 1856 through the influence of the late Peter Cooper, and in his 30 years of service superintended the construction of Minot's Ledge Light, Boston, and other lights along the Atlantic coast to Florida. In 1866 he laid the submarine cable from Florida to Cuba. He finished the Spectacle Reef Light, Lake Huron, in 1871, and concluded his labors as Government engineer by building the Stannard Rock Light in the middle of Lake Superior, the foremost on the chain of lakes and the crowning work of his life.

A New Beam Compass.

The beam compass illustrated was patented last year by Mr. JOS. STRACHAN, formerly an engineer on the South Penna. R. R., but now engaged on the Kings County Elevated Railway in Brooklyn. His design is intended to simplify and cheapen this instrument by greatly reducing the number of parts. The beam and holders alone need be purchased; the pen, pencil or needle point necessary for work with it are found in the outfit of any draftsman or engineer.

The holders are of the usual type secured to the beam by a set-screw; but both holders are exactly alike, and instead of the usual provision for the attachment of special appliances each one is provided with a side clamp as shown. This clamp is simply a pivoted bar of metal with a set screw in the end so placed that anything put between the opposite end of the bar or clamp and the holder is held tightly, whether this object is an ordinary lead-pencil, a drawing-pen, a needle-point or a knife for cutting out curves, etc. In fact, the furniture of this particular beam compass can hardly be lost, for if the holders are all right the remainder of the appliances are found in any instrument-box, or even in the pocket.

The only other peculiar feature about this instrument is embodied in the arrangement of springs shown under each holder. The free end of each spring has sharp teeth and the purpose of this attachment is to exactly adjust the beam-compass to any radius. This is done by clamping the holder so as to admit of a certain motion along the beam and then securing the exact adjustment by pressing the spring against the beam with the finger; the teeth take hold on the beam and the holder slide back or forward as either spring is manipulated.



A Beam-Compass without Special Furniture.

When not in use the springs are turned out of the way as shown to the left of the cut.

Any further information can be obtained from the patentee, Mr. JOSEPH STRACHAN, 322 Madison St., Brooklyn, N. Y.

PUBLICATIONS RECEIVED.

General Specifications for Highway Bridges of Iron and Steel. By J. A. L. WADDELL, Macdonald & Spencer, Kansas City. Pamphlet, 46 pp. 50 cents.

About half of this pamphlet is occupied not with specifications, but with a general discussion of the need for reform in methods of designing highway bridges, and how to effect it, under the heads of "Introductory," "Highway Bridge Failures," "Bridge Lettings," "How Bridges are Built," "How Bridges ought to be Built," "A Proposed Association of Highway Bridge Builders." The latter would undoubtedly correct great evils if effectively organized, and tend in every way to the good of all concerned, but we fear it will be difficult to bring it about. The specifications seem to be carefully worked out, and not materially different from other standard specifications, but full as respects details. We are rather sorry to see such continued multiplication of proposed standard specifications, but except in this general ground we see little to object to in these specifications, while their fullness will perhaps do good, and in many respects they are admirably drawn.

Tables for Calculating the Cubic Contents of Excavations and Embankments. By JOHN R. HUDSON, M. Am. Soc. C. E. Vol. II, New York, John Wiley & Sons, 8 vo, 84 pp., chiefly tables.

The Elasticity and Resistance of the Materials of Engineering. By WM. H. BURR, C. E., formerly Prof. Mechanics, Rensselaer Polyt. Inst. Second Edition, revised and enlarged. New York, John Wiley & Sons, 8 vo. 753 pp.

The Overhead Conductor Electric Railway Co., GEORGE WESTINGHOUSE, Jr. President, THOS. B. KEER, V. Prest and Secretary, Pittsburg, Pa., 8 vo, 82 pp.

This company is organized to introduce the system invented and patented by JOSEPH R. FINNEY, of Pittsburg, Pa., licenses being granted at the uniform rate of $250 per car. A clear and full description of the plant is given, with estimates of comparative cost and reprints of all the important patents.

A Collection of Diagrams, Representing the General Plan of 26 Different Water-Works. Contributed by Members of the New England Water-Works Association, and compiled by a Committee. 1887. Engineering and Building Record, Publishers.

This publication is in the form of a series of plans of a number of New England Water-Works, usually of the smaller size, and nearly every diagram contains data relating to the works and sketches of some of the details. There is no text other than that contained on the drawings; but the date of construction, miles of mains, hydrants services, etc., is there given. There is very considerable useful information in these 26 diagrams and the only regret to be expressed is that the committee did not supplement their otherwise good work by securing the services of a better draughtsman.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—Subscriptions to the Building fund:

Previously reported	$9,069.50
Charles Paine	100.00
John H. Sample	35.00
Total to date	$9,204.50

The Committees to examine the roof of the State Capitol at Albany, N. Y., consists of Messrs. T. C. CLARKE, R. C. UPJOHN and the State Engineer and Secretary of the Society, JOHN BOGART.

Engineers' Club of Philadelphia.—Tenth Annual Meeting, Jan. 14, 1888. President THOMAS M. CLEEMANN in the chair, 44 members and 1 visitor present. The Retiring President, Mr. THOMAS M. CLEEMANN, read the Annual address. Mr. CLEEMANN urged upon the members the necessity of keeping up the Club with the oldest of the young engineers, and reminded them that many of the greatest inventions and discoveries relating to engineering originated in Philadelphia and its vicinity. The first successful steamboat, the first locomotive in America, were made by her citizens. The first permanent tramway, the first engineers' transit, the first modern suspension bridge (with a stiffening truss), the first wire suspension bridge, the first arched bridge hinged at the middle and the ends, all originated in our State.

He recommended a more aggressive spirit in claiming recognition from the city authorities when they required experts to advise them. He referred to the Panama Canal, charging a want of good judgment in its location and management, and claiming that the latest advices, showing an abandonment of the projector's favorite scheme of a sea level canal, so often and obstinately insisted on by him, made the Nicaragua route superior. He also referred to the extraordinary depths of the foundations of the Hawkesbury bridge, the great spans of the bridge over the Firth of Forth, and the proposed North River bridge at New York, to surpass all others in size.

The following Officers for 1888 were then declared elected:

President: JOSEPH M. WILSON. *Vice-President*: J. T. BOYD. *Secretary and Treasurer*: HOWARD MURPHY. *Directors*: T. M. CLEEMANN, FREDERIC GRAFF, Prof. L. M. HAUPT, WASHINGTON JONES, HENRY G. MORRIS.

President-elect JOSEPH M. WILSON, in taking the chair, said:

"Fellow-Members:—I beg to thank you for the compliment you have paid me in electing me to the position of your President, and I trust that I may be able to show my appreciation of the honor and my deep interest in the Club, not only by giving my earnest attention to the duties which appertain to the office, but also by using my utmost endeavor to encourage whatever will tend to the Club's advancement and prosperity. I am very much afraid, however, that my efforts will suffer by comparison with those of my worthy predecessor, whose deep, earnest devotion to the welfare and progress of the Club and close attention to duties, have gained for him a reputation that it would be difficult to surpass.

"A club of this kind has a wide field open to it, with great capabilities or good work, even greater in some respects than would, perhaps, obtain in a more prominent or more widely spread society, where the restrictions and responsibilities are increased. The young life, the liberality as to elegibility, the local interest and acquaintance among the members, and the freedom from the trammels that would encompass an older and more conservative organization, where the establishment of a precedent must always be considered give greater opportunities and enable matters to be taken up and discussed in a way that would hardly obtain elsewhere.

"There are numerous practical subjects of great importance and interest, not only to the engineer, but to the architect, the manufacturer or the citizen, that might be brought before the Club with advantage. Much of this kind of work has already been done, but cannot the usefulness of the Club be still further increased in this direction? For instance, there are local questions upon which a gratuitous opinion from among those best qualified to judge, might be of great benefit to the public. Papers upon the practical details of such matters as lighting by electricity, electro-motors, storage batteries, the heating and ventilating of buildings, sanitation, practical information on the locality and quality of various woods, stones and other materials used in construction, and an almost endless variety of subjects, might be proposed for this purpose. It would be an excellent thing to prepare a list of such subjects and to have it posted where all may see it, and from which selections could be made. Members might hand in new suggestions from time to time, as they felt the want of information. Those papers need not be long—the closer they adhere to the practical part of the subject the better. The Club numbers among its members very many practical men in all departments of engineering, architecture and manufacturing, and its generous policy as to admission to its Associate class makes it just the place for such papers.

The Club has had a good past, it is in the tide of success, and before it lies a great future, if it is properly developed and encouraged. My heart and hand are with it. Will you all join me in wishing it prosperity?"

The Secretary and Treasurer presented his Annual Report for the fiscal year 1887. The following is a statement of the treasury accounts:

Balance, January 8, 1887	$ 365.19
Receipts	4,332.65
	$4,697.84
Expenditures	4,111.36
Balance, January 13, 1888	$ 586.48
Other assets	1,237.20
	$1,823.68
Liabilities, about	41.68
Net assets, about	$1,782.00

MEMBERSHIP.

	Hon.	Cor.	Act.	Asso.
At the end of 1886	3	5	451	9
Additions			30	2
			481	
Deceased	1		1	
			489	
Resignations, etc		5	18	
At end of 1887	2	0	462	11

Net increase of Active Membership, 2⅓ per cent.

Mr. A. Marichal read a paper on the Plan Formation of Quaker Bridge Dam. The topic of his discussion was the report, by the Engineers in Charge, to the Aqueduct Commission, on the "Non-Advisability of Constructing the Dam on a Curve." The author of the paper says: "The formula used by the designers in order to prove that a pressure of 46.8 tons per square foot would be transmitted to the voussoir joints, if the dam would act as an arch, would be good only for an ideal dam, without any thickness, without any elasticity, offering no resistance whatever to the water pressure. As soon as you jump from pure theory into practice, you are compelled to give some thickness to your wall; and no matter how thin it may be, it will offer some resistance to the horizontal thrust of water, and only the excess, not carried by the wall itself, will be transmitted to the abutment, which will react and make equilibrium, provided this reaction does not reach a certain limit." Assuming the limit fixed by the designer to be correct, the author of the paper finds that an increase of 100 per cent. of stability will be introduced by the curved plan, and claims that this additional stability is very much needed. Concluding, he says that the adoption of the straight plan would be the sanction of a false theory. There was some discussion by Mr. J. E. CODMAN, who defended the plan of the dam, quoting abstracts from the report of Chief Engineer CHURCH, from ENGINEERING NEWS of January 14, 1888, p. 20.

Mr. H. S. PRICHARD presented an illustrated description of a Graphical Method of Determining the Deflection of Bridges. An open draw-bridge is chosen for illustration. The usual formula for calculating the variations in the length of each member, due to the strain, is given. Then, by means of diagrams, a graphic method of obtaining the deflections from these variations in length is explained, its application to the draw bridge shown, and suggestions given for its use in other forms of bridges.

HOWARD MURPHY
Secretary and Treasurer.

Ohio Society of Surveyors and Civil Engineers.—The Society held its ninth annual meeting at Columbus, O., Jan. 10, 11 and 12. On Jan. 10 reports were received and the following papers read: "Judicial Functions of Surveyors," by HOMER C. WHITE, of Warren; "The Public Domain," by J. T. BUCH, of Cardington; "Adverse Possession," by E. D. HAZELTINE, of Hazleton; "Steel Tapes as Standards," by Prof. J. B. JOHNSON, of Washington University, St. Louis, Mo. In the evening President W. H. JENNINGS, of Columbus, gave an address, the Committee on Civil Engineering made its report, and the following papers were read: "Road Making Materials of the State," by Prof. E. ORTON, of Ohio State Univ.; "A State Topographical Survey," by C. A. HANLON, of Massillon.

On Jan. 11 there was an exhibition of instruments and the following papers were read: "Philosophy of Under Drainage," by J. ARNETT, of London; "Catfish System of Drainage," by F. M. KENNEDY, of Washington C. H.; "Construction of Turnpikes," by G. S. INNIS, of Columbus; "Notes on Paving," by THOMAS R. WICKENDEN, of Toledo; "Cleveland City Pavements," by M. E. RAWSON; "Comparative Cost and Efficiency of Tile Drains and Open Ditches," by O. B. OPDYCKE, of Bryan; "Street Crossings and Sidewalks," by R. A. BRYAN, of Portsmouth; "Street Grades and Records," by W. H. JENNINGS, of Columbus; "Monumenting," by F. HODGMAN, of Climax; "Construction, Maintenance and Repairs of Short Span Highway Bridges," by S. A. BUCHANAN, of Bellefontaine; "Computation of Strains in Highway Bridges," by Prof. C. N. BROWN, of Ohio State Univ.; "Bridge Details," by H. T. LEWIS; "Lifting and Moving Bridges," by T. H. JOHNSON, of Columbus; "Pile Foundations," by J. GRIGGS, of Columbus; "Masonry as Applied to Railroad Work," by A. G. PUGH, of Columbus; "Puzzles for the Engineer," by W. A. GAIN, of Sidney.

On Jan. 12, reports were presented; the Committee on Legislation was instructed to report to the next annual meeting a bill to govern the qualifications of persons practicing civil engineering in Ohio, and W. H. JENNINGS and others, of Columbus, were authorized to form a local branch of the State association. The following papers were read: "The Circleville Water-Works," by W. C. ROWE; "Mortar," by B. F. BOWEN, of Columbus; "Difficulties of Surveying in the Virginia Military District," by WM. BREDER, of London: "Duplication of Blue Prints," by J. N. BRADLEY, of the Ohio State Univ.; and "Landscape Engineering," by J. L. CULLEY, of Cleveland.

The following were elected to membership in the association: B. E. CUTLER, Zanesville; ALVIN MORROW, Paulding; HARRY E. MANN, Ashtabula; W. H. LEGOITT, Columbus; JAMES T. EGERTON, Ironton; FRANK SNYDER, Columbus; WILLIAM J. HESTER, Cambridge; GEORGE B. NICHOLSON, Cincinnati; M. P. MCCOY, Van Wert; JAMES SWISHER, Urbana; A. W. JONES, Columbus; T. H. DOYLE, Logan; SAMUEL HUSTON, Steubenville; E. C. SLATER, Findlay; D. R. SLATTERMANS, Dayton; H. J. LEWIS, Columbus; M. J. RIGGS, Toledo; G. A. MASTERS, Toledo; SAMUEL BACHTELLE, Columbus; J. M. HARPER, Cincinnati.

The following officers were elected: President, J. D. VARNEY, of Cleveland; Vice President, O. B. OPDYCKE, of Bryan; Secretary, Prof. C. N. BROWN, of Columbus; Treasurer, F. J. SAGER, of Columbus; Chairman of Trustees, W. H. JENNINGS, of Columbus.

Montana Society of Civil Engineers.—The annual meeting of the Society was held at Helena, Mont., Jan. 21. We acknowledge with many thanks the receipt of an invitation to a banquet tendered to the Society by the resident members at Helena.

Engineers' Club of Kansas City—A regular meeting of the Club was held in the Club-room Jan. 9.

There were present Messrs. WM. B. KNIGHT, J. A. L. WADDELL, E. W. GRANT, B. L. MARSTELLER, A. E. SWAIN, W. KIERSTED, E. B. KAY, C. G. WADE, I. F. WYNNE, C. W. HASTINGS, G. W. PEARSONS, JOHN DONNELLY, H. A. KEEFER, E. W. STERN, D. W. PIKE, CLIFT WISE, C. A. BURTON, G. C. STEALEY, R. C. SIMONS, K. ALLEN and 5 visitors. The minutes of the Annual Meeting and of the meeting of the Executive Committee were read and approved.

Ballots for the election of officers for 1888 were canvassed with the following results: President, WM. B. KNIGHT; Vice-President, OCTAVE CHANUTE; Directors, I. F. WYNNE and WM. H. BREITHAUPT; Secretary, Treasurer and Librarian, KENNETH ALLEN.

FRED B. TUTTLE was elected a member. On motion by Mr. MASON it was voted to ballot for the following amendment to Sec. 2 of the By-Laws:

In place of "The annual dues shall be $8 for Members and $7 for Associate Members and Associates;" —for $7 "substitute" $5.

The resignation of the Treasurer to take effect at the next regular meeting, was tendered and accepted. The Secretary read a communication to the Committee on National Public Works from JOHN EISENMANN, Secretary of the Council, and presented for W. D. JENKINS a handsome framed photograph of the C. M. & St. P. Ry. Bridge over the Missouri at Randolph, and for Prof JOHNSON, of St. Louis, a copy of his "Theory and Practice of Surveying." The President then read his Annual Address, and the meeting adjourned.

After the meeting the Club repaired to the Brunswick, where an excellent supper was served to 22 members and 4 invited guests. That the affair was thoroughly enjoyed by all present may be inferred by the difficulty encountered in passing numerous motions to adjourn.

It is hoped the annual supper may become a regular feature of the Club. KENNETH ALLEN, *Secretary*.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

(CONTINUED FROM PAGE 30).

Jamaica, L. I.—The works were commenced in June, 1887, and accepted Jan. 19, 1888; they were designed and constructed by JOHN C. LOCKWOOD, 52 Broadway, New York City. The pumping machinery, valves and hydrants were supplied by the Holly Mfg. Co., of Lockport, N. Y.; the pipe by the Warren Foundry & Machine Co., of Phillipsburg, N. J.; the specials by the Builders' Iron Foundry, of Providence, R. I., and the stand-pipe by Christopher Cunningham, of Greenpoint, L. I. The stand-pipe is 50 ft. diameter and 40 ft. high, set on an elevation; the head is 130 ft. The trenching and pipe laying was done by days work. The hydrant rental is $2,000 per annum for 60 hydrants. The franchise is owned by the Jamaica Water Supply Co.; President, JOHN LOCKWOOD; Secretary, A. K.

GREGORY; Superintendent, JOHN BUSH. The present population is estimated at 5,500.

Patchogue, L. I.—The works were commenced June 1, 1887, and accepted Nov. 29, 1887; they were designed and constructed by JOHN LOCKWOOD, New York City. The pumping machinery was supplied by the Holly Mfg. Co., of Lockport, N. Y.; the pipe by the Warren Foundry & Machine Co., Phillipsburg, N. J.; the specials by the Builders' Iron Foundry Co., of Providence, R. I., and the stand-pipe (100 ft. high) by the Southwark Foundry & Machine Co., of Philadelphia. The franchise is for 50 years and the price per hydrant $40 per annum. The franchise is owned by the Suffolk County Water Co.; President, JOHN LOCKWOOD; Secretary, A. K. GREGORY; Superintendent, WM. E. RITCHIE. The present population is estimated at 5,000.

Vineyard Haven, Mass.—The water-works for Vineyard Haven, town of Tisbury, Mass., were commenced Aug. 12, 1887, and completed Dec. 1, 1887; they were designed by O. G. STANLEY, who was also Constructing Engineer; M. M. TIDD, of Boston, was Consulting Engineer. The work was done under the direct supervision of the engineer; the pumping machinery was supplied by the Geo. M. Blake Mfg. Co., of Boston, Mass.; the pipe by the Gloucester Iron Works and the Warren Foundry & Machine Co.; the specials by the Builders' Iron Foundry, of Providence, R. I.; the valves and hydrants by the Ludlow Mfg. Co., of Troy, N. Y.; and the stand-pipe by Hodges & Co. The stand-pipe is 50 ft. high and 20 ft. diameter. There is no contract with the town for hydrants. The franchise is owned by the Vineyard Haven Water Co.; President, CHAS. C. JACKSON; Clerk, WM. B. OWENS; Superintendent, O. G. STANLEY. The present population is estimated at 1,500.

(TO BE CONTINUED).

CONSTRUCTION NEWS.

Water.

Water Power Canal.—At Columbus, Tex., a canal is projected to furnish water power for manufacturing purposes. The canal would be 4,800 ft. long, from a point on the Colorado river above the city to a point below, and would have a fall of 30 ft. The cost of canal and a dam in the river is estimated by the engineer at $70,000.

Springfield, Mass.—During 1887 the pipe system was extended 2.9 miles. About 2 miles of old cement-lined pipe were replaced with iron pipe and this change must continue gradually until all the cement-lined pipe is replaced.

Kansas City, Mo.—The City Council has passed an ordinance adding an area of about 10 sq. miles to the city, increasing its area to 22 sq. miles. The population of the new territory is between 5,000 and 7,000, making a total of 40,000 for the consolidated city. The extension includes the new water-works at Quindaro, and a large tract of land at the site of the proposed new railroad bridge over the Missouri.

Medford, Mass.—Water was introduced into the town in the fall of 1870, the work being done by George H. Norman under a contract signed May 24, 1870. The works are now under the charge of Superintendent R. M. GOVE. There are 37 miles of pipe and 173 hydrants. The pressure is direct, the water coming from Spot pond, which forms a natural reservoir, 144 ft. above high water mark in the Mystic river. The water is of the best quality. The water debt is $300,000, of which $250,000 falls due in 1890, and $50,000 in 1891. To meet this there is a sinking fund of $75,000 face value, and this, with the additions, will take care of $100,000 when due. It is intended to refund the debt at a lower rate which will be easily taken care of by the water rates, as the works are now practically self-supporting.

New York City.—The Commissioner of Public Works, Gen. JOHN NEWTON, has issued a report containing the following particulars relating to the year 1887: During the year, 56,571 ft. of 6-in. and 24,873 ft. of 12-in. pipe were laid, bringing the total pipe system up to 619.88 miles. Of water meters there are 16,552, measuring 24,771,200 galls. per day. The daily water supply averaged 97,000,000 galls. from the Croton aqueduct and 14,320 000 galls. from the Bronx river conduit. Of sewers 7.12 miles were built, bringing the total up to 421 miles; 43 receiving basins were built. Of street improvement the following work was done: 81,568 cu. yds. earth excavation; 115,307 cu. yds. rock excavation, 331,967 cu. yds. earth filled in; 331,200 sq. ft. flagging, 81,583 ft. curbing. There are 28 miles of macadam road. Of paving there were 11.67 miles of new paving and 7.43 miles of repaving; not including Fifth Ave. Street excavations were made as follows: 99 miles for gas mains, 25.5 miles for electric subway; 4,790 ft. for steam pipes, 3,790 ft. for salt water pipes, 10,500 ft. for street railroads and 17,973 house connections. The city has 1,118 miles of gas mains, and lights 478 miles of streets and 62 acres of parks with 24,719 gas lamps, 331 electric lights and 120 naphtha lamps.

Jamaica, N. Y.—At the meeting of the Village Trustees held Jan. 19, the Water Committee presented its report on the new water-works built by the Jamaica Water Supply Co. The contract was made April 23, 1887, and work was finished in December. On Dec. 31, satisfactory tests were made. There are 6.76 miles of 4, 6, 8, 10 and 12 in. pipe, or 7.14 miles including 4-in. pipe to hydrants; 100 frost proof hydrants and 2 drinking fountains have been put in place. The stand-pipe is of wrought iron, 50 ft. diameter and 46 ft. high, with a capacity of 600,000 galls. and rests on a brick and stone foundation. The height above the average level of Fulton Street is 117 ft., giving a static pressure of 50 lbs. which is sufficient for fire purposes. There are two Gaskill pumping engines of 1,000,000 galls. daily capacity each, against a head of 100 ft., built by the Holly Manufacturing Co., of Lockport, N. Y. The pipe was supplied by the Warren Foundry & Machine Co., 160 Broadway, New York. The analysis of the water shows a good quality. The committee recommended that as the company had laid more than 6 miles of pipe erected 100 hydrants, and secured a good supply of water, that the work be accepted. The works were unanimously accepted by the trustees. JOHN LOCKWOOD, of New York, is President of the company.

Irrigation Ditch Water Rights.—Irrigation ditch companies in Colorado are in trouble. The Supreme Court of this State recently rendered a decision which takes from them the right to sell water rights. A water right is the perpetual right or interest in an irrigation ditch to annually draw or receive from the ditch a stipulated quantity of water. The result of this decision limits the companies, or ditch owners, to simply collecting a toll or assessment annually for the use of the water, and this annual charge can be fixed by each Board of County Commissioners in the respective counties in which the ditch is located, and the law does not allow any appeal from the decision of the Commissioners to another tribunal. Their decision is final. The voters have it all their own way. Before election the candidates are asked for pledges upon the price they will fix for the water, and on that issue they are elected. It is not difficult to find candidates who will accept votes in exchange for a good pledge. With such power in the hands of those who use the water it is easy to understand how ditch-owners fare in the struggle, especially in a mining State like Colorado. Colorado needs agricultural development more than anything else, but this can not be accomplished without the aid of great canals and reservoirs. Canal or ditch investments are now very poor property, and must continue to be so as long as present laws exist.—*St. Louis (Mo.) Globe Democrat.*

Water-Works.—*New Hampshire.*—Concord. The water-works have been extended into Pennacook.——Milford. Water-works are projected.

Massachusetts.—Newton. The City Council will apply to the Legislature for power to issue $350,000 water bonds.

Rhode Island.—Burrillville. The town is contemplating establishing water-works.

New York.—Buffalo. The Water Commissioners recommend that a large storage and distributing reservoir be built without delay on the Dodge farm.——Lansingburg. It is proposed to build a storage reservoir at a cost of $25,000.

Maryland.—Centerville. Water-works are in contemplation.

Ohio.—Bowling-Green. A water works franchise has been granted to Ferris & Halladay, of Jersey City, N. J.——Washington, C. H. The water-works question will be voted on February 6.

Virginia.—Chatham. The city proposes to issue $5,000 in bonds for water-works. Address the Mayor.

Tennessee.—Memphis. The water company will make extensions of its system during the year.

Michigan.—Howell. The citizens are again agitating the water-works question.

Illinois.—Venice. A contract will soon be let for water-works. The arrangements are completed and site selected. The plant will cost about $8,000.——Carlyle. A tax for the support of the new works has been levied. The annual rental for fire purposes, 2 watering places and 1 fountain is $2,100.

Minnesota.—Winona. The City Council will not take a direct supply from the river for domestic purposes but will build a new well and clean out the present one. The cost for the new well, 4 new boilers, compounding the pump and making other improvements will be $21,673.——Sauk Rapids. The St. Cloud Water-Works Co. proposes to pipe a supply to Sauk Rapids.

Iowa.—Burlington. It is reported that the water-works may be sold to an Eastern syndicate.——Glenwood. Water-works are proposed.

Wisconsin.—Sheboygan. The water-works were tested January 17, with satisfactory results. There are 16 miles of pipe.

Kansas.—Strong City.—Water-works will be built.——Eustis. Water-works are to be built. There will be a wind power pumping engine.

Nebraska.—Tecumseh. It is proposed to issue $30,000 bonds for water-works.

Proposals Open.

Water Pipe.—About 25,000 tons of 48-in. pipe. THE AQUEDUCT COMMISSIONERS, 280 Broadway New York City.

Bridge and Jail.—Iron bridge over Hillsborough river; brick jail. Both at Tampa. W. A. GIVENS, Clerk of County Commissioners, Tampa, Fla.

Gas Pipe.—Furnishing and delivering 4,000 ft. of 1¼-in. gas pipe, cut in lengths as required. JAMES BROWN, Comptroller, Allegheny, Pa. Jan. 30.

Armory.—On 4th avenue from 94th to 95th street. Masonry, iron work, carpenter work, steam heating and gas fitting, plumbing and drainage. The Armory Board, Mayor's Office, City Hall, New York City. Jan. 30.

Brick.—Sewer brick, 6,000,000. ANDREW RINKER, City Engineer, Minneapolis, Minn. Feb. 1.

Sewers.—THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. Feb. 1.

Sewers and Street Work.—Main and lateral sewers; grading, paving and curbing. JAMES BROWN, Comptroller, Allegheny, Pa. Feb. 2.

Water-Works Supplies.—Lead pipe and solder, stop and service cocks, stop-cock boxes and stoneware drain pipe. B. R. MORTON, Superintendent of Water-Works, Newport, Ky. Feb. 6.

Dredging.—At pier No. 7, East river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. Feb. 6.

Drawbridge.—Iron drawbridge over Bayou Courtableau. Contractors and builders will do well to furnish plans, specifications and bids. LEON WOLFF, Secretary of Bridge Committee, P. O. Box 27, Washington, La. Feb. 10.

Jail.—Jail and jailors residence; cost not to exceed $30,000. Plans and specifications wanted. W. M. KEY, County Judge, Georgetown, Williamson county, Tex. Feb. 13.

Pile Dike—At Canarsie bay, New York. Lieut. Col. G. L. GILLESPIE, U. S. Engineer Office, corner Greene and Houston streets, New York City. Feb. 15.

Artesian Wells.—Boring from 5 to 10 wells, 5 to 24-ins. diameter. Price per foot for any depth up to 2,500 ft. (See 1st. cover page for advertisement for proposals). ALB. WEIS, Chairman, Water Commissioners, Galveston, Tex. Feb. 15.

Court House.—For Lincoln. Plans and specifications wanted. Cost not to exceed $170,000. O. C. BELL, County Clerk, Lincoln, Neb. Feb. 21.

Sewers.—About 3 miles at Amsterdam. Engineer WM. B. LANDRETH, Schenectady, N. Y. THE SEWER COMMISSIONERS, Amsterdam, N. Y. March. 15.

Contracting.

Stone.—At Toronto, Canada, the Committee on Works has awarded to A. W. Godson the contract for 500 sq. yds. of stone at $2.20 per yd.

Jail.—The Pauly Jail Building & Mfg. Co., of St. Louis, Mo., has the contract for a rotary jail at Dover, N. H., contract price, $26,000.

The Hyatt Filter, now adopted in Atlanta, Ga., has according to the investigations of the Board of Health, reduced the albuminoid ammonia in the city water from 0.10 parts per million to 0.02 parts per million.

New Croton Aqueduct.—The Aqueduct Commissioners recently awarded the contract for the gatehouse and superstructure at South Yonkers, N. Y., on Section 9, to O'Brien & Clark, at $26,935.

Water-Works.—*Pontiac, Mich.* The contract for water-works has been awarded to W. S. Parker & Co. of New York, for about $70,000.

Grading.—The Grade Commissioners who will establish a common grade for the streets running through New Utrecht and Gravesend, L. I., have appointed James T. Carey, engineer of the Commission, he having agreed to perform the work at $70 per mile, the lowest bid.

The Rochester Machinery Mfg. Co., (G. S. Wormer, & Sons, Proprietors), of Chicago, has issued a useful illustrated catalogue of improved hoisting engines, boilers, steam pumps, wire rope, etc. There are large illustrations, descriptions and tables of dimensions, capacities, weights, etc. And a page is devoted to rules for the management and care of steam boilers.

The American Sewer Pipe Co., of Chicago, capital stock, $100,000, has been incorporated by W. W. RAMSEY E. V. JOHNSON, C. H. VEHMEYER and W. B. MATHER.

Bridges.—The contract for Howe truss bridges on the Montana Central R. R. has been awarded to W. G. Coolidge & Co., of Chicago, by E. H. BECKLER, Chief Engineer.

Electricity Applied to the Purification of Water.—Prof. HUGO BLANCK and Mr. R. W. SMITH, of Pittsburgh Pa., are reported to have perfected a method of thoroughly purifying water by passing electrical currents through it. It is said to be simple, but the details are withheld for the present.

Water-Works for Galveston Tex.—The Water Commissioners have awarded contracts as follows:

Pumping engines: two engines, Knowles Steam Pump Co., of New York City.—Boilers; four boilers, Union Iron Works, Chattanooga, Tenn., $5,500.—Pipe and specials: R. D. Wood & Co., Philadelphia, Pa.: 24 and 20-in. pipe $28 per ton; 16-in., $28.20; 12 and 10-in., $29.90; 8 and 6-in., $30.60. Specials, 2.95 cts. per lb.—Hydrants: R. D. Wood & Co., Matthews hydrants.—Valves: Eddy Valve Co., Waterford, N. Y.—Valve boxes & covers: Bingham & Taylor, Buffalo, N. Y.—Pipe laying: H. Merigold & Co., Lima, O., 24 in. 54 cts., 20-in. 48 cts; 16-in. 36 cts., 12-in. 27 cts., 10-in. 24 cts., 8 in. 17 cts., 6-in. 15 cts. Valve boxes and covers, $5 each For 2 ft. covering 5 per cent. less.—Stand-pipe and storage tanks: Moffett, Hodgkins & Clarke, Watertown, N. Y., $17,205 for pipe and $11,668 for tanks.—Buildings and chimney: L. B. Stevens, Toledo, O., $21,500.—Foundations for stand-pipe and storage tanks: L. B. Stevens, Toledo, O.

All the proposals for the supply wells were rejected and new bids will be received till Feb. 15. Daniel Dull, of New York, a contractor for artesian wells, is making examinations and will probably put in a bid.

Ryan & McDonald, of Waterloo, N. Y., manufacturers of steam shovel cars, dump cars, engines, boilers and contractors' supplies have sent us a copy of their illustrated catalogue. It contains descriptions, illustrations and testimonials of dump cars, hoisting plant, portable engines, pumps, etc. There is also a valuable table of cost, etc., of one day's hauling earth from 500 ft. to 1 mile with cars as compared with team work. The firm has been largely engaged in contract work and the design of their cars is the result of practical experience. Another specialty of the firm is the building of stand-pipes, tanks, etc., for water-works.

New York State Appropriations.—Among the bills introduced into the New York State Legislature are the following: Erie canal bridge at Cohoes, $6,000; Newtown creek bridge, $25,000; extending time and altering route of Erie & Central New York R. R.; 3,800 ft. of wall along the Erie canal at Ilion, $31,000; Erie canal bridge at Rome, $6,000; wall and filling along the Erie canal at Rome, $5,000; 5 stone arch culverts over the State ditch at Tonawanda, $17,000; Erie canal lift bridge at Fort Plain, additional $2,500; Erie canal bridge at Frankfort, $3,000; granite paving on Van Brunt street, Brooklyn, $20,000; commission to examine into the safety of ceiling of the Assembly Chamber, $5,000; this commission will be composed of State Engineer JOHN BOGART, THOS. C. CLARKE and R. M. UPJOHN.

Street Lighting.—At Burlington, N. J., the following bids were received by the Lamp Committee: Pennsylvania Globe Gas Light Co., of Philadelphia, (Gasoline Co.), $21.50 per lamp per year for 185 lamps all night. Burlington Gas Co., $28 per lamp per year. Wheeler Kerosene Light Co., $17.50 per lamp per year. The contract was awarded to the first company. No bids for electric light were received.

The Disputed Grading Contract.—William Kelly, the contractor who sued the city to recover about $10,000 for extra work which he claimed to have done in regulating and grading Ninety-third street, between Riverside Drive and West End avenue, New York, has been awarded $3,698.51 by the jury in Judge Barrett's part of the Supreme Court.

Tunnel.—The contract for the building of the Cumberland Gap tunnel and 9 miles of the Powell's Valley R. R., in Tennessee, was awarded Jan. 18 to Mason Hoge & Co., of Frankfort Ky., and Louisville, Ky., lessees of the Kentucky Penitentiary. The tunnel will be about a mile long, through solid rock. It will connect the Powell's Valley R. R., now under construction from Knoxville, Tenn., with the branch of the Louisville & Nashville R. R. from Corbin Station, Ky. Work on the tunnel will be begun in 30 days and must be completed by Sept. 15, 1889. No convict labor is to be used. It will cost $500,000.

Street Railway.—The contract for the first 2 miles of the City Electric Ry., at Little Rock, Ark., has been awarded by Chief Engineer RICKON to R. L. Wilson, of Chicago, Ill.: 1st mile, tram rail; grading, 50 cts. per cu. yd.; hauling and distributing material, 83 cts. per ton for iron and 85 cts. per 1,000 ft. B. M. for lumber; tracklaying, ballasting, etc., $375 per mile. 2nd mile; grading 19½ cts. per cu. yd.; hauling and distributing material, 80 cts. per ton for iron and 80 cts. per 1,000 ft. B. M. for lumber; tracklaying, ballasting, etc., $325 per mile; $300 per mile extra for substituting granite macadam for ballast between tracks and 2 ft. on each side; rock excavation, $1.60 per cu. yd.; trestling and timber work, $12 per 1,000 ft. B. M.; taking up and relaying block paving, $1 50 per sq. yd.—The contract for ties was awarded to W. Hafer at $12 per 1,000 ft. B. M.

Water-Works Supplies.—At Baltimore, Md., the following contracts have been awarded by the Water Department: Pipe, McNeal Pipe & Foundry Co., Burlington, N. J., $74,327 68 (see page 33 for prices). Castings and pipe fittings, H. C. Larabee, 2.22 cts. per lb. Special castings, 2.30 cts. per lb. Lumber, P. Walsh & Sons, $13 per 1,000 ft. B. M. Brass stops and ferrules, Henry McShane & Co., 24 and 14 cts. per lb. Brass castings, Wm. Gisriel, 13 cts. per lb. Jute packing, Johnson Bros., 7 cts. per lb. The pipe contract is as follows: 25,000 ft. of 1¼ in. pipe at .096 per ft., $2,400; 1,000 ft. of 2 in. pipe at .1628 per ft., $162.80; 1,000 ft. of 3-in. pipe at .20090 per ft., $2,009; 35,000 ft. of 4 in. pipe at .30360 per ft., $10,626; 10,000 ft. of 6-in. pipe at .44254 per ft., $4,425.40; 3,000 ft. of 8-in. pipe at .60341 per ft., $1,828.23; 10,000 ft. of 10-in. pipe at .80,630 per ft. $8,063; 3,500 ft. of 12 in. pipe at $1.15 per ft., $4,025; 1,385 tons of 20-in. pipes at $29.45 per ton, $40,788.25. Total amount of the contract, $74,327.68.

Sewers.—*Newark, N. J.*—Contracts have been awarded as follows to James Conway: 15th avenue; 500 ft. of 12-in. sewer pipe, 3 manholes and 1 basin with solid granite head, $686; average cut 12 ft.; 4 bids were received. Barclay street; 700 ft. of 12 in. pipe, average cut 10 ft., 4 manholes and 1 basin, $915; 3 bids were received. ERNEST ADAM, City Surveyor.

Williamsport, Pa.—The lowest bid for the sewers in the 1st and 2nd districts was by R. J. COYLE & Co., of Washington, D. C., about $93,000.

Cincinnati, O.—The following proposals for sewers and drains in the 25th Ward have been received by the Board of Public Affairs: H. J. STANLEY, Chief Engineer: Huston & Walsh, $46,703.90; P. Gleason, $49,441.15: Peter Steele, $49,982.80; P. N. Jonte, $50,734; B. D. Barton, $51,681; H. Nolte, $53,765.40; J. M. Peter, $56,033.60; M. T. T. Flynn, $56,517.95.

Bridges and Canals.

Draw bridge.—A steel drawbridge has been built over the new Welland canal at Thorold, Ont., for the St. Catherines & Niagara Central R. R., by the Hamilton Bridge & Tool Co. Span 311 ft.; width 17 ft. The steel was supplied by the Steel Co. of Scotland, Glasgow. The turntable is a combined rim and center bearing table. The contract price for metal was $33,000; masonry and timber flooring $15,000; total, $48,000.

Viaducts.—The following viaducts have been ordered built by the Commissioner of Public Works, Chicago: Chicago, St. Louis & Pittsburg R. R. Co., successor of the Columbus, Chicago & Indiana Central R. R. Co.; two viaducts, one at W. Madison street, the other at Ogden avenue. Chicago & Great Western R. R. Co., successors of the La Salle & Chicago R. R. Co., two viaducts, Ashland avenue and Ogden avenue. Chicago & Western Indiana R. R. Co., two viaducts, Archer avenue and Thirty-Fifth street. Chicago, Milwaukee & St. Paul R. R. Co., successors of the Chicago & Evanston R. R. Co., two viaducts, Chicago avenue and Kinzie street at Canal. Chicago, Milwaukee & St. Paul R. R. Co., successors of the Chicago & Pacific R. R. Co., Division street and North avenue. These viaducts must all be built according to plans submitted by the Commissioner of Public Works and must be completed by Jan. 1, 1889.

Bridge Notes.—*McKeesport, Pa.*—A bridge is proposed across the Monongahela river, between Reynoldtown and Dravosburg: $55,000 has been subscribed.

Dublin, Ga.—An iron bridge will be built across the Oconee river at a cost of $15,000.

Tampa, Fla.—The county commissioners will build a bridge across the Hillsborough river at a cost of $25,000.

Atchison, Kan.—The city will apply to Congress for an act authorizing a new bridge across the Missouri.

Minneapolis, Minn.—The St. Paul, Minneapolis & Manitoba R. R. will build a truss bridge of 72 ft. span across its tracks on Lyndale avenue.

The Bonner Springs & Wilder Bridge & Ferry Co., of Kansas City, Kan., has been incorporated at Topeka, Kan., by P. M CLARK and J. W. MCDANIELS, of Bonner Springs, and D. E. CORNELL, I. D. WILSON, W. J. BURNHAM and WINFIELD FREEMAN, of Kansas City, Kan. Capital stock, $30,000.

Canals.—Work on the Louisville & Portland canal, in Kentucky, has not proceeded as fast as was expected, and the improvements are only about half completed. When these improvements are completed the canal will be 230 ft. wide at the narrowest part near the mouth, and 475 ft. in some places.

The Des Moines Rapids Improvement & Mfg. Co. has been incorporated by H. R. DICKINSON, of Hamilton, Ill., and ALEX. COLLIER and HUGH ROBERTSON, of Keokuk, Ia., with a capital stock of $1,000,000. It is proposed to build a water power canal for the Des Moines rapids, above Hamilton, Ill., to a point between Hamilton and Warsaw.

Surveys have been made for the canal to connect Lake Chipola, Fla., with the East bay. A company has offered to construct the canal for $8,000.

The Fowl River Improvement & Canal Co. has been incorporated at Mobile, Ala. President, C. C. KAUFMAN, of New Orleans, La.; Secretary, F. P. ANDREWS.

RAILROADS

[On account of the space taken up this week by our summary of work in the Northwestern States, we are obliged to condense our Railroad News and give space to only the most important items.—ED. ENG. NEWS.]

East of Chicago.

Existing Roads

Lehigh Valley.—The extensions of the company's system during the past year, given in the annual report, were from New Boston to Hazleton, Luzerne to Harvey's Lake, the Nescopec branch, and the Wilkesbarre Mountain line. The extension in New Jersey from New Brooklyn to Roselle, which is now under construction, is a move toward a terminus at New York City in connection with the Central of New Jersey system. There are also indications that the company intends to do considerable work on the northern extensions the coming season. A line has been surveyed from Geneva to Buffalo and a surveying corps is now at work on a ten mile branch from near Union Springs on the Cayuga branch to Auburn, N. Y., and it is rumored that the survey will extend to Syracuse.

Chicago & Grand Trunk.—The right of way has been secured for a branch from Mishawaka, Ind. to Elkhart, 11 miles. An associated press report says "the branch will be extended 50 miles to Jackson, Mich., the terminus of the Michigan Air Line division, giving a shorter line from Detroit to Chicago than the present one by 50 miles." Should the proposed line be constructed, and a reasonably direct location be secured, the Detroit—Chicago line would be shortened only about 10 miles at most.

Erie & Central New York.—A bill is before the New York Legislature extending the time for completing this line 5 years, and authorizing a change in its location in Cortland and Broome counties. LEWIS S. HAYES, Cortland, N. Y., is President.

Quebec & Lake St. John.—Contracts have been signed between the company and H. J. BEEMER, of Montreal, involving about $3,000,000. The main line is to be extended westward to deep water at Roberval. The eastern extension is to go to Chicoutimi and possibly to St. Alphonse harbor, 65 miles in all. Branches are to be built from Lake Edward to La Tuque, on the St. Maurice river, 30 miles; and from St. Gabriel to River aux Pins, 10 miles.

Rochester, Hornellsville & Lackawanna.—This New York road from Hornellsville to Perkinsville, near Wayland, 10 miles, has been completed and opened for business.

New Projects and Surveys.

New York & Long Island.—For news in reference to this enterprise see "Engineering News" page.

Gloucester & Rockport.—A three mile railroad is projected between these Massachusetts towns. MORRIS C. FITCH of Gloucester is President.

Elkton, Denton & Cape Charles.—The citizens of Caroline county, Md., are anxious to secure railroad facilities for a connection with Baltimore. At a mass meeting held at Denton, Md., Jan. 16, it was voted to organize a company under the above name, and to extend aid to it from the county of Caroline to the amount of $100,000. The ultimate object is to encourage the Baltimore & Ohio company to build the line.

SOUTHERN.

Existing Roads.

Cape Fear & Yadkin Valley.—The company has agreed to build the 80-mile extension to Wilmington, N. C., for a subscription from that city of $150,000. Work to begin in four months from the time the contract is signed and to continue without interruption until completion. There is little doubt that the city will ratify the contract which its commissioners have made, and that the extension will be built the coming season.

Illinois Central.—A recent visit of President STUYVESANT FISH to Memphis, together with the information extracted from him by persevering newspaper reporters, indicates that the company is seriously considering the extension from Cairo to Memphis, which is now under survey and is likely to build it at an early date.

Orange Belt.—This Florida road is now completed from Longwood south 120 miles, and the remaining 20 miles from Tarpon Springs to St. Petersburg is under construction.

Natchez, Jackson & Columbus.—This company has been reorganized with the following officers: President, Jos. W. DREXEL, New York City; Vice-President and General Manager, T. J. NICHOLL, Natchez, Miss. It is probable that the proposed change of gauge and extension will be undertaken the coming season.

New Projects and Surveys.

Fauquier & Rappahannock.—A bill has been introduced in the Virginia Legislature to incorporate this company to build a railroad from some point on the Virginia Midland or Shenandoah Valley railroads to Sperryville. H. G. MOFFET Jr., formerly State Railroad Commissioner, is one of the incorporators.

Athens & Jefferson.—

ATHENS, Ga., Jan. 17, 1888.

EDITOR ENGINEERING NEWS:

The preliminary line for this road has been surveyed and estimates based thereon have been handed the President. The road will extend from Athens to Jefferson, 18½ miles. Right of way is secured except for entrance to the towns, and subscriptions to the company's stock have been made along the route. It is hoped that the road will be built this year. O. R. HODGSON is acting President of the company.

DAVID C. BORROW, Jr., *Chief Engineer.*

THE NORTHWEST.

Existing Roads.

Red River Valley.—Since the list of work in the northwest was in type we have received the following data from ALEXANDER STEWART of Winnipeg, Chief Engineer of this road: Under construction, Winnipeg to West Lynne, 65 miles. Projected, Winnipeg to Portage La Prairie, 55 miles.

New Projects and Surveys.

Omaha, Yankton & Northwestern.—Incorporated at Omaha, Neb., by ANDREW ROSEWATER, City Engineer of Omaha, and others.

Moorhead, & Lake Superior,—Incorporated in Minnesota to build a railroad from Moorhead to some point on Lake Superior. THOS. C. KUATZ of Moorhead, President, W. H. DAVY, Moorhead, Secretary.

THE SOUTHWEST.

Existing Roads.

Fort Worth & Denver City.—Grading has been completed on the Main line through the Texas Panhandle and New Mexico, and tracklaying is making rapid progress so that the 50 mile gap will be closed by March 15. Graders have begun work on the 20 mile branch to Panhandle City, the present terminus of the Santa Fé's Kiowa extension.

Houston & Texas Central.—The extension from Roberts, Tex., to Paris is again under consideration, and the towns along the route have been asked for aid.

St. Louis & San Francisco.—The Kansas City *Times* asserts that this company is to build no less than three lines to that city. One from Pierce City, Mo.; one from Tulsa, Ind. Ter., to Coffeyville, Kan., and thence over the Kansas City & Pacific; and a third whose route "has not been fully decided upon." It is also reported that the line from Salem to Little Rock, Ark., will be built this season.

New Projects and Surveys.

Louisiana, Arkansas & Missouri.—This company has entered into contract with the Levee board of the Tensas basin levee district in Arkansas to build a levee across the Bœuf cut-off swamp in Arkansas, a distance of 23¾ miles, which will also be used as a road bed for the railroad. ARTHUR W. SOPER of New York City is President of the company, LOGAN H. ROOT of Little Rock, Ark., is Secretary.

Kansas City, Arkansas & New Orleans.—

BEEBE, ARK., Jan. 19, 1888.

EDITOR ENGINEERING NEWS:

Our road is to run from Beebe, Ark., to Monroe, La., *via* Monticello and Bastrop, about 200 miles. A branch is proposed to Pine Bluffs, Ark., and an extension to Morgan City, La. The line runs through a level prairie region and grades will not exceed 15 ft. per mile. Preliminary surveys have been made and the final line is now being run. Right of way is secured and a New York syndicate will furnish capital for building. Contracts for grading will probably be let in May. Major W. R. BERGHOLZ, 15 Cortlandt Street, N. Y., is Chief Engineer.

GEO. M. BARBOUR, *President.*

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Mexican National.—On the extension from Saltillo to San Miguel, Mex., 364 miles, about 80 miles of grading and 25 miles of track laying has been completed from Saltillo south. Graders are also working from San Miguel north, and will begin laying track by Feb. 15. It is expected that the grade will be completed by July 1, and the line will be opened for traffic early in September.

Denver & Rio Grande.—The Rio Grande & Pacific company has been organized with President D. H. MORFAT at its head, and it is reported that surveyors are already at work on the line which is to run from Glenwood Springs, Col., *via* Grand river and White river valleys to the State line and thence to Salt Lake City. While this route does not closely parallel the Denver & Rio Grande Western from Grand Junction to Salt Lake City, as was at first reported, it may still be questioned whether the project would be pushed if the line of the latter company was under control of the Denver & Rio Grande.

Southern Pacific.—The late reports from San Francisco state that all parties engaged on preliminary surveys have been called in from the field. It is hardly likely, however, that the stoppage of work is more than temporary.

New Projects and Surveys.

Boston, Trinidad & Western.—Incorporated in Colorado to build a railroad from Trinidad to a point on the east line of the State. I. B. COLLIER of Trinidad is President. The enterprise is to be pushed for the purpose of inducing the Rock Island system to build to Trinidad.

Billings, Clark's Fork & Cooke City.—This Montana company has filed a mortgage for $2,000,000 to the Farmers' Loan & Trust Company of New York City CHAS. F. ROBERTS of New York City is President.

Statistics of Railroad Construction!

NORTHWESTERN STATES.

Accompanying Map No. 5, of the Progress and Prospects of Construction.

The classification by "Existing Roads" and "New Projects and Surveys" is the same that is used in our Railroad News, the latter including only the schemes and surveys of new and independent companies which have not yet let contracts. "Track laid" is for the calendar year 1887, except where noted. "Under contract," "Under construction," and "Graded" signify different stages of work represented on the map by one symbol. "Under survey," "Surveyed," and "Located" indicate different stages of progress on lines not yet under contract. And "Projected" indicates lines on which no surveys of amount have been made, together with some on which work has been for some time suspended, both of which, however, from all the data furnished us we conclude to have some chance of construction within a reasonable time. Names and post office addresses of officers are given for those roads not found in Poor's Directory.

Corrections and additions to the list and Map, and further information regarding the progress of the various enterprises is especially requested. Our thanks are extended to the officers of the roads and other correspondents who have favored us with the information from which the list has been prepared.

ILLINOIS.

Existing Roads.

Centralia & Ste. Genevieve.—Under contract, Centralia to Ste. Genevieve, 70 miles. President, Thos. B. Needles, Nashville, Ill. Chief Engineer, H. W. Schmidt, Red Bud, Ill. Contractor, F. M. Gillet, 37 East 31st street, New York City.

2. *Chicago & Eastern Illinois.*—Track laid, Danville to Tuscola, 50 miles. Surveyed, Tuscola to Shelbyville, 45 miles; Momence, Ill., to Goodland, Ind., 35 miles.

3. *Chicago, Milwaukee & St. Paul.*—Surveyed, Evanston to Highwood, 15 miles.

4. *Chicago, Santa Fé & California.*—Track laid, Ft. Madison to Ancona, 132 miles.

5. *Fulton County Narrow Gauge.*—Under survey, Galesburgh to Mount Carroll, 90 miles.

6. *Illinois Central.*—Track laid, Freeport to Rockford, 28 miles. Under construction, Rockford to Elmhurst, 68 miles. Projected, Havana, Leroy & Western R. R., Leroy to Clinton, 15 miles.

7. *Illinois Valley & Northern.*—Track laid, Walnut Junction to C. B. & Q. crossing, 14 miles; Streator to Ticona, 12 miles. Under construction, C. B. & Q. crossing to Ticona, 30 miles. Chief Engineer, Robt. L. Engle, La Salle, Ill.

8. *Indianapolis, Decatur & Western.*—Projected, Decatur to Springfield, 35 miles.

Jacksonville Southeastern.—Track laid, Centralia to Driver's Station, 20 miles. Projected, Driver's Station to Benton, 23 miles.

Kaskaskia, St. Elmo & Southern.—Projected, Altamont to Paducah, Ky., 160 miles. Considerable grading was done some time ago, but lately the enterprise has been at a stand still. President, B. F. Johnson, St. Elmo, Ill. Chief Engineer, Robt. Carrick, Metropolis, Ill.

11. *Lake Erie & Western.*—Track laid, Bloomington to Mackinaw River, 17 miles; Peoria towards Bloomington, 5.8 miles. Under construction, from Mackinaw River to end of track, 15 miles.

12. *Michigan Central.*—Track laid, Hammond, Ind., to South Chicago, 5 miles.

13. *Minnesota & Northwestern.*—(Now Chicago, St. Paul & Kansas City.) Track laid, Dunbar to Aiken, 50 miles. Projected, Sycamore to Keithsburg, 135 miles.

14. *Ohio & Mississippi.*—Projected, Beardstown to Keokuk, Ia., 60 miles.

Pittsburg, Ft. Wayne & Chicago.—Track laid, Colehour Junction to South Chicago & Southern Junction, 9 miles.

St. Louis, Alton & Springfield.—(Formerly St. Louis & Central Illinois.) Surveyed, Alton to Elsah, 12 miles; also, Calhoun & Northern, Grafton north, 50 miles.

St. Louis, Alton & Terre Haute.—Chicago, St. Louis & Paducah Ry., track laid, Marion to Burnside Jct., 15 miles. Under construction, Burnside Jct. to Paducah, Ky., 25 miles.

18. *St. Louis & Chicago.*—Track laid, Litchfield to Mount Olive, 10 miles. Under contract, Springfield to Eureka, 72 miles. Under survey, Mount Olive to East St. Louis, 42 miles.

New Projects and Surveys.

Cairo & Northwestern.—Projected, Cairo to East Cape Girardeau, 45 miles. President, F. Bross, Cairo, Ill. Secretary, H. Wells, Cairo, Ill.

Chicago Paducah & New Orleans.—Projected, Effingham south to connect with Paducah & Mt. Vernon Ry., 75 miles. For officers see Paducah & Mt. Vernon Ry.

21. *Milwaukee & Peoria.*—Projected, Milwaukee, Wis., to Peoria, Ill., 200 miles. President, E. H. Waldron, Phœnix Building, Chicago, Ill. Secretary, C. A. Haslett, Phœnix Building, Chicago, Ill.

Paducah & Mt. Vernon.—Under contract, Cypress Junction to Paducah, Ky., 66 miles. Projected, Cypress Junction to Mount Vernon, Ind., 44 miles. President, E. A. Quintard, New York. Financial Agent, Amasa Mason, 120 Broadway, New York.

22. *Quincy & Beardstown.*—Projected, Quincy to Beardstown, 50 miles. Secretary, Joseph H. Carter, Quincy, Ill.

23. *Springfield & Southern Illinois.*—Located, Springfield to Pinckneyville, 125 miles. President Rufus N. Ramsey, Carlyle, Ill. Chief Engineer, Geo. W. Davis, 219 South 23rd street, St. Louis, Mo.

St. Louis, Grand Tower & Southern.—Surveyed, St. Louis to Grand Tower, 80 miles. Chief Engineer, H. A. Schwanecke, East St. Louis, Ill. Secretary, L. D. Cantrill, Springfield, Ill.

25. *Springfield, Shelbyville & Mount Carmel.*—Preliminary survey made, Springfield to Mount Carmel, 135 miles. President, J. M. Howard, Effingham, Ill. Chief Engineer, A. B. Fitch, Terre Haute, Ind.

Venice, Marine & Eastern.—Projected, East St. Louis to Effingham, 85 miles. Secretary, William H. Jones, St. Louis, Mo.

Total.—Track laid, 377 miles; under construction, 346 miles; under survey, 614 miles; projected, 875 miles.

WISCONSIN.

Existing Roads.

27. *Chicago & Northwestern.*—Projected, Lake Geneva & State Line Ry, Geneva, Wis., to Harvard, Ill.; 20 miles.

28. *Chicago, Burlington & Northern*—Projected—Portage & Southwestern, Ry., East Dubuque, Ill., to Portage, and branch to Madison, 150 miles.

3. *Chicago, Milwaukee & St. Paul.*—Track laid, between Mather and Goodyear's Mills, from end of existing track, 9 miles; Albany to New Glarus, 16 miles; Merrill to Minocqua, 54 miles. Under survey, Berlin to Wausau, 75 miles; Minocqua to L'Anse, Mich., 100 miles; Minocqua to Union Bay, Mich., 75 miles. Projected, Milton Junction, Wis., to Libertyville, Ill. 65 miles.

27. *Chicago, St. Paul, Minneapolis & Omaha.*—Track laid, end of track to Neilsville, 1 mile.

29. *Duluth, South Shore & Atlantic.*—Under construction, Ashland to end of track 40 miles. President, Jas. McMillan, Detroit, Mich. Principal Assistant Engineer, John F. Stevens, Marquette, Wis.

6. *Illinois Central.*—Track laid—Chicago, Madison & Northern Ry., Buena Vista, Ill. to Madison, Wis., 62 miles.—Freeport, Dodgeville & Northern Ry., Cedarville, Ill., to Blanchardville, 35 miles. Under construction Freeport, Dodgeville, & Northern Ry., Blanchardville to Dodgeville, 22 miles.

30. *Milwaukee, Lake Shore & Western.*—Track laid, Hurley Branch southwest, 7 miles. Under construction, Rhinelander north, 41 miles. Projected, end of grade to Hurley, 33 miles.

31. *Minneapolis, Sault Ste. Marie & Atlantic.*—Track laid, Rhinelander to Sanders Point, 85 miles; Minneapolis to Turtle Lake, 73 miles; Godfrey Junction to St. Croix, 4 miles. Surveyed, branch to Florence, 25 miles.

32. *Sault Ste. Marie & Southwestern.*—Track laid, Fairchild to Osseo, 14 miles. Under survey, Osseo to Alma 54 miles; Fairchild to Abbotsford, 50 miles. President, N. C. Foster, Fairchild, Wis.

33. *Wisconsin Central.*—Track laid, Mellen to Bessemer, Mich., 34 miles. Surveyed, Rib Lake to Tomahawk, 28 miles; Abbotsford to Merrill, 40 miles; Merrill Junction to Wausau, 20 miles; Marshfield west, 12 miles.

New Projects and Surveys.

34. *Canada, La Crosse & Southwestern.*—Surveyed, Des Moines, Ia., to Wausau, Wis., 360 miles. President, F. A. Roziene, care Mercantile Safe Deposit Co., New York City. Secretary, Alex. R. Spriggs, Charles City, Ia.

35. *Chicago, Lake Geneva & Pacific.*—Surveyed, Lake Geneva to Portage, 110 miles. President, John E. Burton, Lake Geneva, Wis. General Manager, Howard Morris, Milwaukee, Wis.

36. *Chippewa Falls & Ashland.*—Under survey, Chippewa Falls to Ashland, 130 miles. President, T. C. Pound, Chippewa Falls. Secretary, L. J. Rusk, Chippewa Falls.

37. *Fox River Valley.*—Projected, Oshkosh to Berlin, 23 miles. General Offices at Berlin.

38. *Wisconsin Midland.*—Surveyed, Fond du Lac to Crystal Falls, 216 miles, Kaukauna to Sturgeon Bay, 72 miles. Projected, Crystal Falls to L'Anse, Mich., 60 miles, Fond du Lac to Madison, 75 miles. President, A. G. Ruggles, Chief Engineer, N. Boardman. Secretary, Dana C. Lamb, all of Fond du Lac, Wis.

Total.—Track laid, 375 miles; Under construction, 88 miles, Under survey, 1,339 miles, Projected, 394 miles.

MICHIGAN.

(*Northern Peninsula*)

Existing Roads

27. *Chicago & Northwestern.*—Track laid, Iron River to Watersmeet, 35 miles, Mastodon to Dunn Mine 3 miles. Under construction, Ishpeming to Michigamme, 20 miles. Projected, Metropolitan to Republic, 22 miles, Michigamme to L'Anse, 12 miles.

29. *Duluth, South Shore & Atlantic.*—Track laid, Sage to Sault Ste. Marie, 60 miles; Nestoria to 12 miles west of Dogwood, 120 miles. For officers, see Wisconsin.

39. *Milwaukee & Northern.*—Track laid, Iron Mountain to Champion, 55 miles.

31. *Minneapolis, Sault Ste. Marie & Atlantic.*—Track laid, west boundary line of Michigan to Sault Ste. Marie, 192 miles.

Total.—Track laid, 473 miles. Under construction, 35 miles. Under survey, 110 miles. Projected, 94 miles.

MANITOBA.

Existing Roads.

40. *Port Arthur, Duluth & Western.*—Under construction. Port Arthur to International boundary, 85 miles. President, Thomas Marks, Port Arthur, Ontario. Chief Engineer, Henry K. Wicksteed, Port Arthur, Ontario.

Red River Valley.—Graded, Winnipeg to International boundary, 65 miles. Built under direction of Manitoba Government; address, Winnipeg, Manitoba.

Winnipeg & Hudson Bay.—Track laid, Winnipeg to Lake Manitoba, 40 miles. Projected, Lake Manitoba to Grand Rapids. President, Hugh Sutherland, Winnipeg, Manitoba.

MINNESOTA.

Existing Roads.

28. *Chicago, Burlington & Northern.*—Surveyed Prescott Wis. to Duluth, 150 miles.

3. *Chicago, Milwaukee & St. Paul.*—Track laid Hopkins to Lake Minnetonka, 8 miles.

13. *Chicago, St. Paul & Kansas City.*—Surveyed St. Paul to Superior, Wis., 165 miles.

41. *Duluth & Iron Range.*—Under construction. Tower to Chandler mine, 21 miles.

42. *Duluth, Huron & Denver.*—Under construction, Sauk Center to Dakota Line, 92 miles. Under survey, Sauk Center to Mille Lacs, 85 miles General offices, Sauk Center, Minn.

31. *Minneapolis, Sault Ste. Marie & Atlantic.*—Under construction, St. Paul Branch Junction to Minneapolis, 5 miles.

43. *Minnesota & Southeastern.*—Track laid, North Pacific Junction to Carpenter's Hills, 7 miles. Under construction, Carpenter's Mills southeast, 9 miles. Under survey, end of grade to Superior Junction, Wis., 45 miles. President, Jas. M. Paine, Minneapolis, Minn. Chief Engineer, Asa Paine, North Pacific Junction, Minn.

44. *Northern Pacific.*—Surveyed, Little Falls to Aldrich, 38 miles.

45. *St. Paul & Duluth.*—Track laid, Thomson to Grassy Point, 16 miles. Projected, Duluth to connection with Port Arthur, Duluth & Western Ry., at International boundary, 150 miles; St. Paul to Omaha, Nebraska, 300 miles.

46. *St. Paul, Minneapolis & Manitoba.*—Track laid, Benson to Watertown, Dakota, 92 miles; Tintah Juction to Evansville Junction, 32 miles; Moorhead to Wahpeton, 43 miles. Under construction,—Willmar & Sioux Falls Ry., Willmar to Sioux Falls, Dak., 147 miles; Crookston to Fosston, 45 miles; Crookston Junction south, 30 miles. Under survey, Fosston to Milaca 175 miles; Halstead to Grand Forks, Dakota, 50 miles; Hinckley to Superior, 70 miles. Projected, St. Cloud to Little Falls, 32 miles; end of Crookston Junction extension to Pelican Rapids, 60 miles.

47. *Wisconsin, Minnesota & Pacific.*—Track laid, Eagle Lake to Mankato, 10 miles.

New Projects and Surveys.

48. *Duluth, Fergus Falls & Southern.*—Surveyed, Tintah to Leech Lake, 125 miles. President, Jacob Austin, Fergus Falls, Minn. Chief Engineer, N. D. Miller, St. Paul.

49. *Duluth, Red Wing & Southern.*—Surveyed, Duluth to Albert Lea, 250 miles. Projected, Albert Lea to Sioux City, Ia., 175 miles. President, F. W. Hoyt Red Wing, Minn. Secretary, P. H. Crary, Red Wing, Minn.

50. *Grand Marais & Vermilion.*—Projected, Grand Marais to Gunflint Lake, 40 miles. Secretary, Chas. E. Monroe, Milwaukee, Wis.

51. *Hutchinson, Redwood Falls & Sioux Falls.*—Projected, Hutchinson to Sioux Falls, Dak., 180 miles. President, O. B. Turrell, Redwood Falls, Minn.

52. *Lake Superior & Pacific.*—Surveyed, Duluth west, 30 miles. Projected to Crookston, 200 miles. President, J. R. Myers, Duluth, Minn. Chief Engineer, W. B. Silvey, Duluth, Minn.

53 *Lake Superior & Southwestern.*—Projected, Red Wing to Clear Lake, Ia., 125 miles. President, A. Knox, Austin, Minn.

54. *Minnesota Northern.*—Under survey, Fergus Falls south to State line, 200 miles. President, C. H. Smith, Wortsington, Minn. Chief Engineer, D. F. Woolstoncraft, Fulda, Minn.

55. *Mississippi, Faribault & Northwestern.*—Located, Winona to Willmar, 190 miles. General offices, Faribault, Minn.

56. *Winona & Southwestern.*—Under survey, Winona to Mason City, Ia., 110 miles. Projected, Fort Dodge, Ia., to Omaha, Neb., 130 miles. President, Wm. Mitchell, Winona, Minn. Secretary, Thos. Simpson, Winona, Minn.

Total.—Track laid, 173 miles; Under construction 322 miles; Under survey, 1,361 miles; Projected 877 miles.

DAKOTA.

Existing Roads.

57. *Aberdeen, Bismarck & Northwestern.*—Graded, Aberdeen to Bismarck, 140 miles. Surveyed, Bismarck northwest to McLean County coal fields, 45 miles. Projected, Aberdeen to Watertown, 80 miles. Vice-President and General Manager, E. P. Wells, Aberdeen, Dak. Chief Engineer, W. L. Richards, Jamestown, Dak.

27. *Chicago & Northwestern.*—Track laid, Faulkton to Gettysburg, 41 miles; Verdon to Groton, 14 miles. Surveyed, Gettysburg to Forest City, 20 miles; Pierre to Cheyenne River, 120 miles. Projected, Doland to Iroquois, 45 miles.

3. *Chicago, Milwaukee & St. Paul.*—Track laid, Lake Preston to Bristol, 73 miles; Roscoe to Eureka, 26 miles.

27. *Chicago, St. Paul, Minneapolis & Omaha.*—Track laid, Salem to Mitchell, 33 miles.

58. *Forest City & Watertown.*—Surveyed, Forest City east, 60 miles. Projected, to Watertown, 100 miles. President, R. M. Springer, Forest City, Dak. Chief Engineer, F. G. Brooks, Forest City, Dakota.

27. *Fremont, Elkhorn & Missouri Valley.*—Track laid, Rapid City to Whitewood, 36 miles.

59. *Minneapolis & Pacific.*—Track laid, Lidgerwood to Junction with Eendale & Edgeley Branch of C. M. & St. P. Ry., 70 miles.

60. *Minnesota & Dakota.*—Under construction, Fargo northwest to near New Rockford, 200 miles. Projected, north to International boundary and west to Missouri river, 200 miles. President, Henry Cutler, North Wilbraham, Mass. General Manager, Isaac Britton, Fargo, Dak. Contractor, Job Voak, Wilmot, Wis.

44. *Northern Pacific.*—Track laid, Grand Forks to International boundary, at Pembina 96 miles; La Moure to Edgely, 21 miles. Surveyed, Johnston to International boundary, 40 miles; Edgely to Fort Yates, 85 miles; boundary between Logan and McIntosh counties to near Bismarck, 57 miles; near Bismarck north, 45 miles.

61. *Rapid City, Wyoming & Western.*—Surveyed, Rapid City to Deadwood, 40 miles. President, E. B. Chapman, Rapid City, Dak.

46. *St. Paul, Minneapolis & Manitoba.*—Track laid, Minot to Great Falls, Mont., 350 miles; Rutland Junction to Ellendale, 49 miles; Rugby Junction to Battineau, 38 miles; Park River to Langdon, 40 miles. Under construction, Watertown to Huron, 70 miles; Church's Ferry to Cando, 16 miles. Located, Duluth, Pierre & Black Hills Ry., Aberdeen to Pierre, 129 miles. Under survey, Huron to Woonsocket, 20 miles; Sioux Falls to Yankton, 65 miles.

New Projects and Surveys.

Duluth, Fargo & Black Hills.—Under contract, 82 miles. President, Geo. Foley, Fargo, Dak.

63. *Duluth, Milbank & Southwestern.*—Projected, Morris, Minn., to Sioux Falls, Dak., 175 miles. General offices at Milbank, Dak.

64. *St. Paul, Black Hills & Pacific.*—Projected, Dickinson, to Deadwood, 200 miles; Aberdeen to Milnor, 78 miles. President S. H. Jumper, Aberdeen, Dak. Chief Engineer, W. L. Richards, Jamestown, Dak.

Total.—Track laid, 748 miles; Under construction, 535 miles; Under survey, 726 miles; Projected, 1,033 miles.

NEBRASKA.

Existing Roads.

28. *Burlington & Missouri River.*—Track laid, Central City to Arcadia, 70 miles; Palmer to Burwell, 69 miles; Greely Center to Ericson, 17 miles; Orleans to Blakeman, Kan., 95 miles; Grand Island & Wyoming Central Ry., Anselmo to Range 45, Town 26, 150 miles; Nebraska & Colorado Ry., Curtis to Cheyenne, Wyo., 1254 miles; Omaha & North Platte Ry., Ashland to Schuyler, 50 miles. Under construction, end of track north of Greely Center to Cedar City, 11 miles; Arcadia to Brewster, 45 miles; Burwell north, 5 miles; Blakemann, Kan., to Wano, Kan., 35 miles; Culbertson to Holyoke, Colo., 84 miles; end of track, Anselmo Extension, west, 25 miles, Crete to Milford, 13 miles; Stamford south, 9 miles.

65. *Chicago, Kansas & Nebraska.*—Track laid, Sabetha, Kan., to Almena, Kan., 241 miles; Fairbury to Nelson, 51 miles. Projected, Nelson to Hastings, 40 miles; Omaha *via* Lincoln and Dewitt to Fairbury, 100 miles; Beatrice *via* Nebraska City to Carson City, Ia., 100 miles.

3. *Chicago, Milwaukee & St. Paul.*—Surveyed Omaha to Madison, 100 miles.

27. *Fremont, Elkhorn & Missouri Valley.*—Track laid, Linwood to Geneva, 77 miles; Arlington to Omaha, 27 miles; Irvington to Omaha stock yards, 10 miles; Lindsay to Oakdale, 53 miles; Platte River Junction to Hastings, 120 miles.

66. *Kansas City, Wyandotte & Northwestern.*—Surveyed, Seneca, Kan., to Kearney and Lindsay, Neb. 300 miles.

67. *Missouri Pacific.*—Track laid, Warwick, Kan., to Lawrence, Neb., 35 miles; Auburn Junction to Weeping Water, 43 miles. Under construction, Hastings to Lawrence, 26 miles; Crete branch, graded, Talmage to Crete, 80 miles.

68. *St. Joseph & Grand Island.*—Track laid, Kansas City & Omaha Ry., Sutton to Stromsburg 45 miles; McCool Junction to near Powell's, 44 miles; near Fairchild to Alma, 85 miles.

69. *Union Pacific.*—Track laid, Omaha & Republican Valley Ry., end of track to Nantasket, 1 mile. Also O. & R. V. Ry., graded, Nantasket to Pilot, 30 miles; partly graded, North Bend to Stanton, 40 miles; Kearney to Milldale, 75 miles. Work on each of the above has been at a stand still for several months.

New Projects and Surveys.

70. *Lincoln, Red Oak & Des Moines.*—Projected, Lincoln to Des Moines, Ia. 180 miles. Secretary, J. M. Raymond, Lincoln, Neb.

71. *Omaha & Yankton.*—Projected, Omaha to Yankton, Dak., 150 miles. President, Harvey N. Sheppard, Boston, Mass. Secretary, James F. Dillon, Omaha, Neb.

Total.—Track laid, 1,173 miles; Under construction, 429 miles; Under survey, 505 miles; Projected, 420 miles.

IOWA.

Existing Roads.

72. *Cedar Rapids & Manchester.*—Under construction, Cedar Rapids to Manchester, 37 miles. Superintendent, Wm. Elsom, Cedar Rapids, Ia.

27. *Chicago & Northwestern.*—Track laid, Kingsley to Moville, 9 miles. Under survey, Moville to Sergeant Bluffs, 16 miles.

3. *Chicago, Milwaukee & St. Paul.*—Track laid, between Ottumwa, Ia., and Kansas City, Mo., 170 miles; between Sioux City and Manilla, 13 miles.

13. *Chicago, St. Paul & Kansas City.* Track laid, Des Moines, to St. Joseph, Mo., 159 miles, 140 miles laid on Jan. 1, 1888; Oelwein to Waterloo, 26 miles.

4. *Chicago, Santa Fé & California.*—Surveyed; Keokuk & Santa Fé Ry., New Boston to Keokuk, 12 miles.

73. *Davenport, Iowa & Dakota.*—Under construction, Davenport to Independence, 100 miles. General offices at Davenport, Ia.

6. *Illinois Central.*—Track laid, Cherokee & Dakota Ry., Cherokee to Sioux Falls, Dak., 96 miles; Cherokee to Onawa, 59 miles. Surveyed, Washta to Sioux City, 32 miles; Le Mars to Yankton, Dak., 65 miles; Osage City to connect with Cherokee & Dakota line in Wheeler township, 140 miles.

74. *Webster City & Southwestern.*—Track laid, Webster City to Border Plains, 13 miles. General offices at Webster City.

Total.—Track laid, 290 miles; Under construction, 137 miles; Under survey, 505 miles; Projected, 655 miles.

Missouri, Kansas, Colorado and Wyoming.

(Summary for these States and other work in progress therein will be given on maps and lists for Southwestern and for Rocky Mountain and Pacific States).

4. *Chicago, Santa Fé & California.*—Track laid, Kansas City, Mo., to Ft. Madison, Ia., 226 miles; surveyed, Edina Branch, 6 miles. Projected, Independence Branch, 4 miles.

75. *Chicago, Kansas & Southwestern.*—Projected, Parnell City, Mo., to Hiawatha, Kan., 100 miles. President, Joseph Jackson, Maryville, Mo. Secretary, Geo Boon, Hiawatha, Kan.

76. *Kansas City, Lawrence & Nebraska.*—Surveyed, North Lawrence, Kan., to Grand Island, Neb., 279 miles. President, Howard M. Holden, Kansas City, Mo. Chief Engineers, Breithaupt & Allen, Kansas City, Mo.

69. *Union Pacific.*—Track laid, end of track 50.7 miles north of Cheyenne, Wyo., to Cottonwood, 74.3 miles; Loveland, Col., to Buckhorn stone quarries, 8.8 miles.